CANADIAN ELECTRONICS ENGINEERING

APRIL 1959
A Maclean-Hunter publication
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APR 14 1959

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The transistor as a four-terminal network 25

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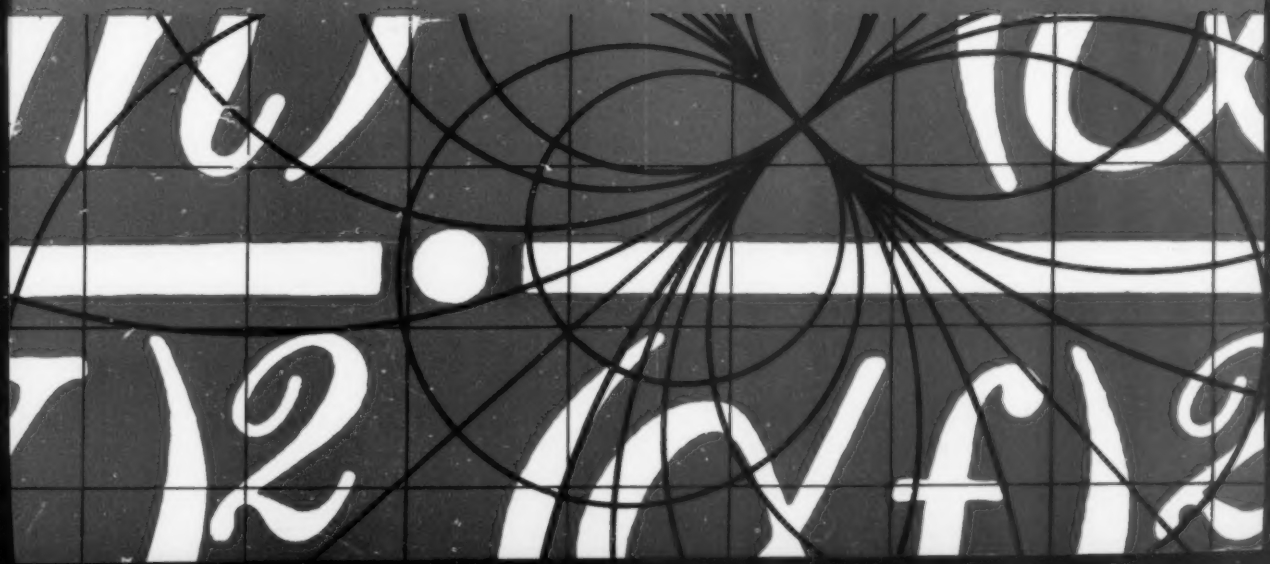
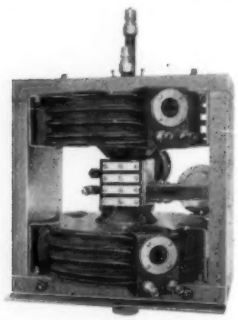


ANOTHER VARIAN FIRST!

2 kW SHF Varian Klystron



The VA-804D (4.85—5.0 kMc) mounted in its focusing magnet, the VA-1504.

A vital component of the new Canadian Westinghouse SHF scatter transmitter, now being operated in a "proving ground" circuit between Hamilton and Kinmount, Ontario, is the Varian VA-804 klystron amplifier, designed specifically for forward scatter communication service. The now familiar qualities of all Varian klystrons — remarkable efficiency (see below), economy, reliability, and proved performance — made this tube the logical choice for Westinghouse.

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Efficiency — 40% nominal

For a complete description of this and other Varian klystrons contact your local Varian Representative or write Varian Associates, Application Engineering Department.

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For further information mark No. 46 on our Readers' Service Card

April 1959

Volume three, number 4

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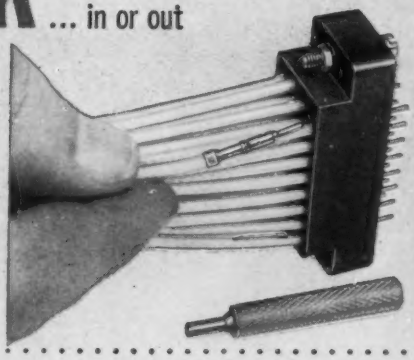
***our cover design** *Occasionally an artist has a bit of luck. It happened this month when the design curves for the admittance quadripole formed an interesting and artistic pattern.*

CRIMP at bench...or at equipment

Precision hand, pneumatic, or automatic tooling guarantees uniform and complete crimp for each connection —a measurable quality control —at a high speed production rate.

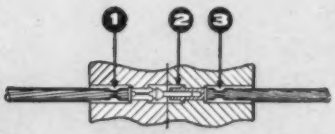
SNAP-LOCK ... in or out

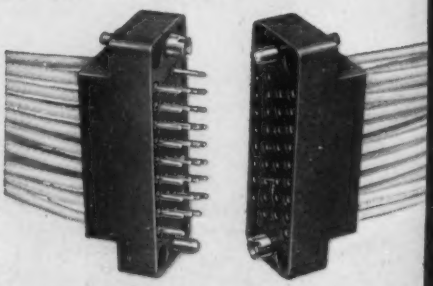


Pins and sockets are easily and quickly snap-locked into plugs and receptacles. They may be removed with a simple extraction tool for circuit changes or checks.

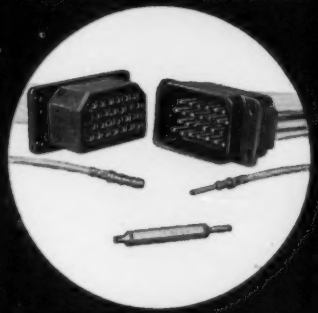
CONNECT ... only 3 points of contact

The HYFEN method provides the minimum number of contacts—3—thereby reducing reliability problems. Exceeds the requirements of MIL-C-5015C and MIL-C-8384A.

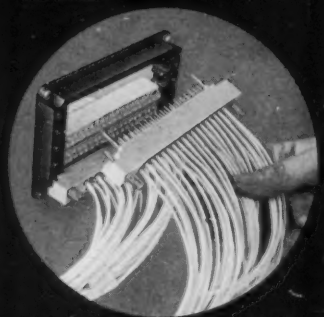




ACCEPTED! Hyfen Variations



ME rack and panel HYFEN connector. 8 or 26 place configuration. One-piece shell and one-piece block. Also available for coaxial or shielded cable.



Feed-thru, modular design, multiple insert connector. 35 contact inserts can be removed from frame for easy contact insertion or removal. 5 or 8 insert frames available.

Printed circuit connector in either 31 or 45 place configuration. Accommodates single wire or combinations of wire sizes.

HYFEN types illustrated are typical of those already supplied to the industry by BURNDY. HYFEN connectors are engineered to meet specific requirements. For other types or sizes, contact BURNDY.

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with crimp-type snap-locked contacts

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contributors and special articles in this issue:

It is interesting to see the many ways in which the design of circuits can be approached. This is particularly true of the semiconductors where some new design techniques have been introduced, but where well-established techniques have been adapted too.

This month two authors present entirely different philosophies for the design of circuits using transistors. **Malcolm A. Gullen** (The transistor as a 4-terminal network) was born in Edinburgh and received his education there, including an honour physics degree from Edinburgh University. He has served with the RAF technical signals and transport command.

In 1949 Mr. Gullen entered Purdue University, Indiana, to take his masters degree in electrical engineering. After graduation in early 1951 he gained some experience in TV picture tube production with CBS-Hytron, Newburyport, Mass. Later that same year he moved to Ottawa to work with the Department of National Defence on the development of Army signals equipment.

Mr. Gullen is a part-time instructor in electronics at the Eastern Ontario Institute of Technology. He is active in the Boy Scouts Association and counts 35mm photography and hi-fi among his other interests.

During discussions with the editors of CEE it became apparent that Mr. Gullen is keenly interested in being 100% Canadian. He has received his Canadian citizenship papers and is doing everything possible to further the interests of his adopted country.

H. L. Armstrong (How to design transistor amplifiers) was working with Pacific Semiconductors, Inc., Culver City, California at the time he prepared this article on a simplified method of designing amplifier stages. Mr. Armstrong now is with the department of physics at Queen's University, Kingston, Ontario.

Canadian companies are now faced with a situation that has not existed before. There is little prospect of obtaining large defence electronics contracts except from the U. S. Government. This means that Canadian companies must get out and sell their products, skill and facilities to the Americans. CEE has established plans to help this program in every way possible, consistent with its primary function as a technical journal.

This month marks the start of a new series on company profiles. These will provide a brief look at the companies in our industry. Also in this issue is a description of the vehicle identification system developed by Electronic Associates Ltd., Willowdale, Ont. This industrial application of radioisotopes will be displayed by EAL at their booth in the 5th Nuclear Congress, Cleveland, Ohio, April 5-10.

CEE will have more news for its readers in the near future regarding ways to sell to the American market.

Gullen

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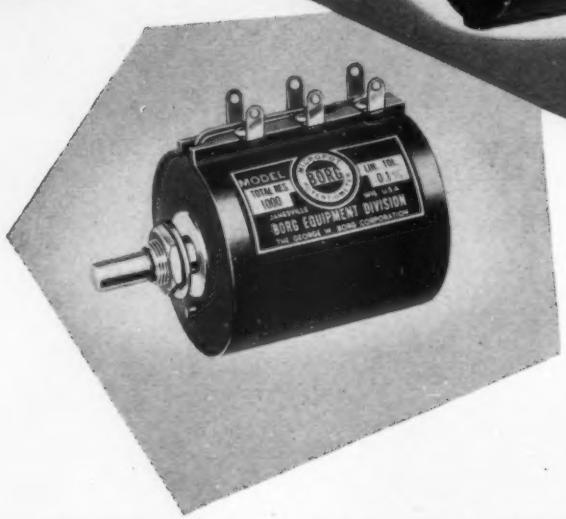

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Testing of this type tells us how life and reliability are affected . . . the environmental limitations for each model . . . which series to recommend for your specific job!

You may be using high-priced pots unnecessarily in your present project. You may be able to reduce the number of components in your circuits. Remember . . . the fewer the components, the greater the reliability!

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News highlights . . .

New tube could bring color tv soon . . .

A new single-gun color tv tube has been developed using layers, rather than dots of colored phosphors. Inventors claim that b&w sets could be converted for about $100. Research is continuing on converters that will permit NTSC signals to be used directly with the new system. One possibility: CBC receive NTSC signals, convert and rebroadcast in the simpler Willer system. A Canadian company is raising further capital to continue the development work.

TCA orders electronic reservation system . . .

Trans-Canada Airlines has placed orders for the field and communication equipment to be used in their new electronic reservation system. These local message distributors and transactors have been ordered from Ferranti-Packard Electric Ltd. at an estimated cost of $2,000,000. Bids for construction of a central computer have been called. Expected completion date: January 1962.

RCAF orders radar from U. K. firm . . .

E.M.I. Electronics Ltd., England, will build an advanced type of airborne radar equipment for use in the RCAF submarine hunting planes. The equipment will be installed in the Argus aircraft based at Greenwood, N.S. The equipment contract amounts to more than $1,000,000.

CGE gets large order for tv camera chains . . .

Canadian General Electric Co. Ltd. has just completed delivery of six dual portable camera chains to the Canadian Broadcasting Corp. Included were 12 cameras with accessory components such as power supplies, switchers and monitors. The equipment will be used during the forthcoming Royal Tour.

Dominion Electrohome issues new shares . . .

To increase working capital to support its expanding operations, Dominion Electrohome Industries Ltd., Kitchener, Ont., propose to offer rights to its shareholders for purchase of an additional 12,000 shares. Upon completion of this transaction, all common shares will be divided 3:1.

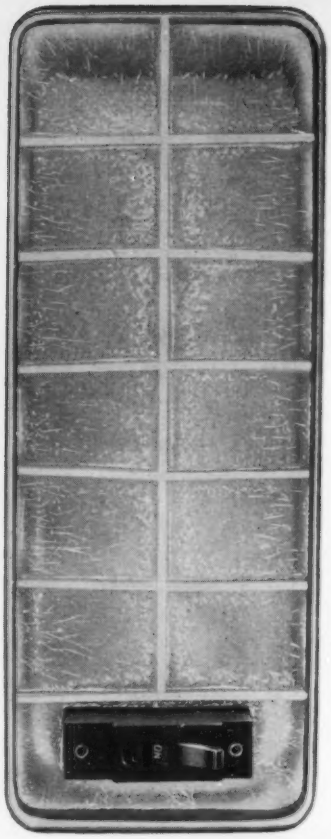
Order placed for Newfoundland cable . . .

The Canadian Overseas Telecommunications Corp. has placed a $2,500,000 order with Submarine Cables Ltd., Britain, for manufacture and establishment of a repeater submarine telephone cable system between Newfoundland and the Canadian mainland.

IRE National Convention highlight . . .

Items that attracted a lot of attention at the 1959 IRE show included the Photocircuits Corporation printed-circuit motor. This new development includes a printed armature such that the motor will respond to frequencies as high as 100 cps. The manufacturers claim that it is the only dc motor known that combines a high starting torque with wide frequency response.

Want temperature-stable overcurrent protection?



HEINEMANN CIRCUIT BREAKERS GIVE YOU CURRENT RATINGS AND TRIP POINTS INDIFFERENT TO AMBIENT HEAT AND COLD

Hydraulic-magnetic actuation is responsible for the Heinemann circuit breaker's exceptional temperature stability. This type of magnetic current sensing is completely independent of thermal effect. Result: the breaker will always trip predictably, according to specification . . . will always carry its full, rated nameplate current. De-rating — or any sort of temperature compensation — is absolutely unnecessary. The rating is permanent. And because the circuit breaker does not have to be replaced, this rating becomes a permanent part of the protected equipment . . . virtually a guarantee against mistakes or misuse.

Doesn't it seem reasonable that such thoroughly reliable, foolproof overcurrent protection might just be best for the equipment you make? This degree of protection permits you to reduce costs by engineering for normal operating conditions. Let the Heinemann circuit breaker worry about abnormal conditions.

Some further investigation on the subject could repay you handsomely. A good start: the *Heinemann Circuit Breaker Engineering Guide,* Bulletin 201. It contains much useful information. Send for a copy.

HEINEMANN ELECTRIC COMPANY **166 PLUM ST., TRENTON 2, N.J.**

For further information mark No. 25 on our Readers' Service Card

Canadian Admiral Corp. appoints Stuart Brownlee president

At a board of directors' meeting, held recently, **Stuart D. Brownlee** was appointed president of Canadian Admiral Corp. Ltd., succeeding Vincent Barreca. Mr. Barreca has been named executive vice-president of Admiral Corp., Chicago.

Mr. Brownlee has been associated with the Canadian radio, television and appliance industry for the past 25 years. He was appointed executive vice-president and a director of Canadian Admiral three years ago. Brownlee was previously president of Canadian Radio Patents Limited and general manager of the Electronics Industries Association of Canada.

New editor for NBS Journal

Dr. James R. Wait, consultant to the director of the Boulder Laboratories, National Bureau of Standards, Boulder, Colorado, will develop and edit a national scientific publication—Section D of the NBS Journal of Research.

The new publication will be issued July 1 as a quarterly devoted to research and development in radio propagation, communications and upper atmospheric physics.

Born in Ottawa, Dr. Wait received his Ph.-D. in electromagnetic theory from the University of Toronto in 1951. He later worked with Newmount Exploration Ltd., Jerome, Ariz., doing theoretical and experimental research in electrical prospecting, and for DRB, Ottawa.

He joined the staff of NBS in 1955 and was promoted last December to the position of consultant to Dr. Fred W. Brown, director. On February 16 he received the Department of Commerce Exceptional Service Award.

President and director at Ward Leonard of Canada

Ward Leonard of Canada Ltd., announced the election of **James Boles, P.Eng.,** as president and member of the board of directors.

Born in Saskatchewan, Mr. Boles graduated from Queen's University and came to Ward Leonard from the defense electronic products division of RCA Victor Co. Ltd. Prior to that he served in engineering production and quality control capacities with Canadian General Electric Co. Ltd. and Canadian Westinghouse Co. Ltd.

Heads up sales drive

Hackbusch Electronics Ltd., Canadian distributors for Stromberg-Carlson, has appointed **A. L. Pringle** sales representative for Stromberg-Carlson's hi-fidelity and stereophonic component line. The latter is expanding its activities with a nation-wide sales program aimed at creating more dealerships in all provinces for the consumer lines. Mr. Pringle heads up the drive.

Microwave communications sales specialist

Canadian General Electric Co. Ltd. has appointed **Mr. C. C. Strong** as microwave communications sales specialist with the electronic equipment and tube section.

Mr. Strong received his diploma in electrical engineering while with the General Electric Co. of England. He has worked with the Ontario Hydro and was project engineer with the New Brunswick Telephone Co. on the transCanada microwave link. He is a graduate of England's Coventry Technical College.

Northern Electric appoints two zone managers

D. K. Atkinson has been appointed sales manager of the eastern zone of Northern Electric Co., Ltd.

Born in Scarborough, Ontario, Mr. Atkinson graduated from Queen's University in 1929, where he received a B.A. degree with honours in mathematics and physics.

Atkinson

MACKIE

Bartlett

Succeeding Mr. Atkinson is **L. G. Bartlett,** who has become sales manager of the company's western zone.

Mr. Bartlett was born and educated in Vancouver, joining the Northern Electric Co. Ltd. there in 1925.

Canadian engineer at Beckman & Whitley

In his appointment to the post of chief engineer of the instrument division of Beckman & Whitley, Inc., San Carlos, Calif., **Charles Nater** brings an international touch to the job. A graduate BSME from Manchester University, England, he is a Canadian citizen.

His major career activities to date have been with Canadian Westinghouse Co. Ltd., Hamilton.

Joining Canadian Westinghouse in 1951, Mr. Nater was successively a senior industrial engineer in the electronics and power division, chief project engineer working on torpedoes in the electronic division, assistant division manager in the radio and tv division, and production-engineering and production manager for the Velvet Glove and Sparrow II missiles.

(Continued on page 45)

Wait

GARBER

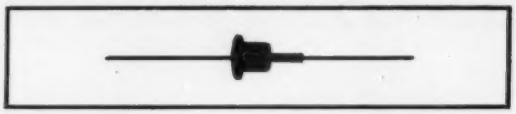
Boles

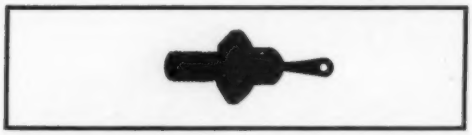
MILNE

Pringle

Strong

HOW THE C-G-E 4-POINT PLAN SOLVES YOUR SEMI-CONDUCTOR PROBLEMS IN THE LAB AND ON THE JOB





Canadian General Electric was first in Canada to produce semi-conductor products to meet the special needs of Canadian manufacturers of electronic equipment. They also realize that, with the rapidly expanding use of these comparatively new products, application and other problems may arise. To help you solve your semi-conductor problems, and give you better service, Canadian General Electric offers you this 4-point plan.

Technical Sales Team. The technically qualified members of C.G.E.'s sales team are at your service. You can depend on them for expert assistance in selecting the right product to do the best job at the lowest cost.

Application Engineering Lab. The experienced personnel in C.G.E.'s Application Engineering Lab are always ready to investigate your specific problems. Very often they can recommend alternative solutions that will lower your production costs and result in superior performance.

Production Know-how. Because of the first-hand experience gained from semi-conductor production, C.G.E. engineers can solve your problems right here in Canada. This eliminates time consuming and costly long distance solutions which very often prove unsatisfactory.

Complete Customer Service. C.G.E. fills your semi-conductor needs completely. They can supply you with other makes, as well as General Electric semi-conductors. Their efficient method of order expediting, complete warehouse stocks, and immediate price information on over 1,700 types of semi-conductors, saves you time, money and importation headaches.

When you need help with your semi-conductor problems, price and availability information, contact or write directly to Electronic Tube Section, Canadian General Electric Co. Ltd., Dufferin Street, Toronto, Ontario.

GENERAL ELECTRIC
SEMI-CONDUCTORS

Electronic Tube Section

1647-159

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

For further information mark No. 19 on our Readers' Service Card

Canadian radio week will stress importance of radio today

Plans for the 3rd annual Canadian Radio Week, scheduled May 3-9, include the distribution of separate promotion kits for dealers and member radio stations. Produced in both French and English, dealer kits will contain window streamers, price display cards, radio set sales figures and a sales letter outlining why and how the dealer can benefit by tying in with this national promotion. The radio station kits will be similarly geared to the interests of member stations of the Canadian Association of Broadcasters. Details and plans were presented them during the annual convention at Toronto last month.

Vancouver dealers organize

Determined to raise the standards of the electronics servicing industry to a higher level, Vancouver legitimate dealers recently organized to strengthen their voice in dealing with the situation.

Incorporated under the B. C. Societies' Act, The Electronic Servicing Dealers Association in December received its charter from Chris Boulton, British Columbia Division manager, Retail Merchants' Association of Canada.

The new association is showing great promise with more than 50% of the dealers already holding membership.

"Service dealers in the Greater Vancouver area have been faced with chaotic conditions arising from cut-rate service calls, 'gypo' shops and part-time repair men who are not in the trade," Robert Swirhun of Regal Radio & Television, president of the association, told CEE.

"These people offer ridiculously low rates on evening and Sunday service work. The legitimate service dealer, who is striving to get a just rate and provide competent, honest service, is finding the going very hard because of this situation, which has been deteriorating steadily during the past four years.

"Our association aims to remedy this by working toward the establishment of a high standard of ethics, business practice and service, among the retail radio, television and electronic companies.

"We also aim to improve, promote and protect the interests of the radio, television and electronic service companies and the public; and to establish better relations with other segments of the industry and with the public."

Canadian heads subsidiary

The formation of a new Speer Carbon subsidiary, Speer Carbon Company of Canada Limited, and the appointment of **R. W. Spafford** as its general manager have been announced by Andrew Kaul III, Speer's president.

Mr. Spafford, a Canadian, is a graduate of the University of Toronto with a degree in electrical engineering. He has had over 11 years' experience in the carbon and graphite industry.

The new company, located at 305 Decarie Blvd., Ville St. Laurent, Que., will manufacture Speer brand carbon brushes, and will market these and the many other carbon, graphite and electronic products made under the trademarks Speer, International Graphite and Electrode (IGE) and Jeffers.

Distributor for Kleinschmidt

Smith-Corona (Canada) Ltd. is developing a sales and service organization to distribute printed communications equipment for the Kleinschmidt Division of Smith-Corona Marchant Inc. of Syracuse, N.Y. Heading up the new communications division is **Harvey Cowling**, sales manager.

Instrumentation and measurement consulting service

Mr. **Vaino Ronka** has formed a new company, Vaino Ronka Consultants, to provide design and consultation services for mining companies and geophysicists.

Mr. Ronka was formerly associated with the Hunting Group and Ronka Geophysical Instruments Ltd., where he designed ground and airborne electromagnetometer systems. The new address is 69 Hurlingham Crescent, Don Mills, Ont. Telephone: HIckory 7-7075.

Record 1958 for Canadian firms

At least two firms, Canadian Admiral and Dominion Electrohome Industries, reported a marked reversal of the 1958 industrial trend.

Canadian Admiral increased its December sales 45% and ended the year with $1.5 million more than in 1957. Though the tv industry generally was down, Admiral's business climbed 40% to put them in the top tv sales bracket for the ninth time in 11 years.

Dominion Electrohome also reached a new sales high of $15,421,000, up 6.1% from the 1957 total. Net profit in '58 climbed 73% to a record $552,000, or $5.10 per common share.

(Continued on page 45)

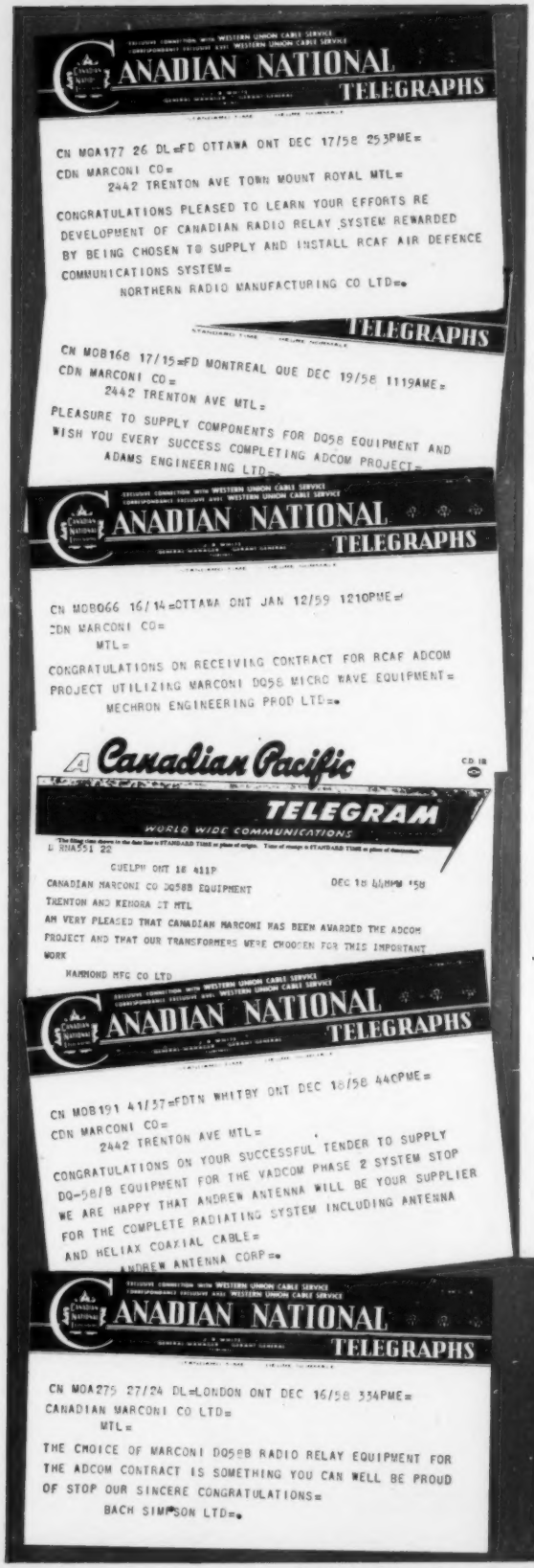
Spafford

TAYLOR

Cowling

WARNER

Ronka



CANADIAN NATIONAL TELEGRAPHS

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CDN MARCONI CO=
2442 TRENTON AVE TOWN MOUNT ROYAL MTL=
CONGRATULATIONS PLEASED TO LEARN YOUR EFFORTS RE DEVELOPMENT OF CANADIAN RADIO RELAY SYSTEM REWARDED BY BEING CHOSEN TO SUPPLY AND INSTALL RCAF AIR DEFENCE COMMUNICATIONS SYSTEM=
NORTHERN RADIO MANUFACTURING CO LTD=

TELEGRAPHS

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CDN MARCONI CO=
2442 TRENTON AVE MTL=
PLEASURE TO SUPPLY COMPONENTS FOR DQ58 EQUIPMENT AND WISH YOU EVERY SUCCESS COMPLETING ADCOM PROJECT=
ADAMS ENGINEERING LTD=

CANADIAN NATIONAL TELEGRAPHS

CN MOB066 16/14=OTTAWA ONT JAN 12/59 1210PME=
CDN MARCONI CO=
MTL=
CONGRATULATIONS ON RECEIVING CONTRACT FOR RCAF ADCOM PROJECT UTILIZING MARCONI DQ58 MICRO WAVE EQUIPMENT=
MECHRON ENGINEERING PROD LTD=

Canadian Pacific TELEGRAM WORLD WIDE COMMUNICATIONS

L RNA551 22
GUELPH ONT 18 411P
CANADIAN MARCONI CO DQ58B EQUIPMENT DEC 18 4LMPM '58
TRENTON AND KENORA ST MTL
AM VERY PLEASED THAT CANADIAN MARCONI WAS BEEN AWARDED THE ADCOM PROJECT AND THAT OUR TRANSFORMERS WERE CHOOSEN FOR THIS IMPORTANT WORK
HAMMOND MFG CO LTD

CANADIAN NATIONAL TELEGRAPHS

CN MOB191 41/37=FDTN WHITBY ONT DEC 18/58 44CPME=
CDN MARCONI CO=
2442 TRENTON AVE MTL=
CONGRATULATIONS ON YOUR SUCCESSFUL TENDER TO SUPPLY DQ-58/B EQUIPMENT FOR THE VADCOM PHASE 2 SYSTEM STOP WE ARE HAPPY THAT ANDREW ANTENNA WILL BE YOUR SUPPLIER FOR THE COMPLETE RADIATING SYSTEM INCLUDING ANTENNA AND HELIAX COAXIAL CABLE=
ANDREW ANTENNA CORP=

CANADIAN NATIONAL TELEGRAPHS

CN MOA275 27/24 DL=LONDON ONT DEC 16/58 334PME=
CANADIAN MARCONI CO LTD=
MTL=
THE CHOICE OF MARCONI DQ58B RADIO RELAY EQUIPMENT FOR THE ADCOM CONTRACT IS SOMETHING YOU CAN WELL BE PROUD OF STOP OUR SINCERE CONGRATULATIONS=
BACH SIMPSON LTD=

Canadian Pacific TELEGRAM WORLD WIDE COMMUNICATIONS

VOA24 58/35 5 ST NL
VANCOUVER BC 28
CANADIAN MARCONI CO JAN 28 3 26PM '59
97C MCEACHRAN AVE MTL
WE WISH TO CONGRATULATE YOU ON BEING AWARDED THE PRIME CONTRACT FOR ADCOM TWO A MOST IMPORTANT SECTION OF THE CANADIAN DEFENSE SYSTEM STOP WE ARE HAPPY TO WORK WITH YOU IN SUPPLYING A COMPLETELY COORDINATED LENKURT SUPERVISORY AND CONTROL SYSTEM AS WELL AS OTHER SPECIALIZED ITEMS FOR THIS CONTRACT
LENKURT ELECTRIC CO OF CANADA LTD
7018 LOUGHEED HIGHWAY NORTH BURNABY

CANADIAN

ADOPTED FOR

DQ58 Microwave Radio Relay Equipment

CMC CANADIAN MARCONI COMPANY
DESIGNED, DEVELOPED AND MANUFACTURED IN CANADA

APPLICATION:

To convey a T.V. channel or a large number of audio or data channels over large distances with a very high standard of performance and reliability. Channel drop and insert facilities are available.

Equipment can be installed in duplicate, complete with automatic change-over facilities, or alternatively twin-path operation with two equipments operating in tandem at different RF frequencies. Both systems can be engineered to give reliabilities in excess of 99.99%.

The DQ58 gives:

1. **High quality equipment at moderate cost**
2. **Long trouble-free service**
3. **Front access for easy maintenance**

WE ARE AT YOUR SERVICE

Should you require further information regarding our range of equipments and their integration to communications system, please write to us.

You are also cordially invited to see our equipment and demonstration links and to discuss your requirements.

For further information mark No. 20 on our Readers' Service Card

MARCONI'S NEW DQ58

CANADA'S AIR DEFENCE SYSTEM

BRIEF SPECIFICATION OF DQ58B

TUNING RANGE:
1700 — 2300 Mc/s

MODULATION:
F.M.

TRANSMITTER OUTPUT POWER:
10 watts minimum

RECEIVER NOISE FACTOR:
Better than 13db

BASEBAND TERMINAL TO TERMINAL:

Order wire	.3 to	3.5 kc/s ± 1db
Fault alarm	4 to	10 kc/s ± 5db
Traffic	12 to	1052 kc/s ± 2db
	60 to	1052 kc/s ± 1db
	60 to	2540 kc/s ± 2db

BASEBAND REPEATER TO REPEATER OR TERMINAL:
Drop and insert facilities
12 to 108 kc/s ± 1db

INPUT LEVELS:

Order wire	−14dbm minimum
Fault alarm	−36dbm minimum
Traffic	−39dbm minimum

OUTPUT LEVELS:

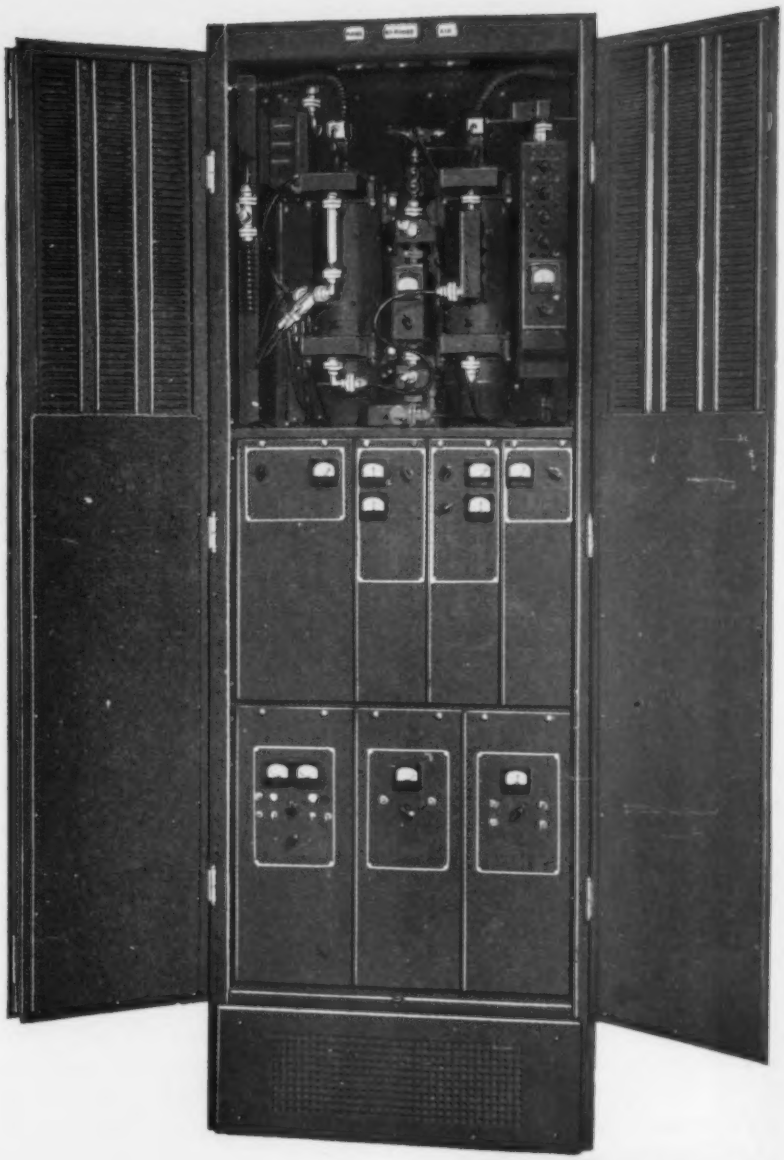
Order wire	+10dbm maximum
Fault alarm	−12dbm maximum
Traffic	−15dbm maximum

IMPEDANCES:
Traffic 75 ohms unbalanced
F.A. and EOW—600 ohms unbal.
R.F. 50 ohms unbalanced

POWER SUPPLIES:
100 — 125V
200 — 250V } ±5%
55 to 65 c/s

CABINET SIZE:

Width	32″
Depth	18″
Height	93¼″
Total weight	615 lbs.



CANADIAN MARCONI COMPANY,

CANADIAN MARCONI COMPANY

RADIO RELAY DEPARTMENT,
970 McEACHRAN AVENUE, MONTREAL 8, CANADA. TEL: CR. 6-3627.

CMS-59-3

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"LET'S ACT NOW AND ORDER OUR SPACE IN CEE'S 1959-60 COMPONENTS AND EQUIPMENT DIRECTORY"

Every progressive manufacturer of electronic equipment and components will want to advertise in Canadian Electronics Engineering's 1959-60 ANNUAL DIRECTORY—published in June.

Here's why! The CEE COMPONENTS & EQUIPMENT DIRECTORY is the only purchasing guide in Canada's electronic field with . . .

- A TRADE NAME INDEX.
- Advertisers KEYED TO THEIR DIRECTORY LISTINGS by special markings (designed to help readers refer to advertisements for detailed product information).
- TELEPHONE NUMBERS LISTED so that readers can make fast contact with manufacturers or suppliers.

This COMPONENTS & EQUIPMENT DIRECTORY is one of the year's best advertising buys. Almost 8,500 copies will be distributed to electronic engineers in management, research, design and application.

Grasp this splendid sales opportunity. Reserve dominant advertising space now.

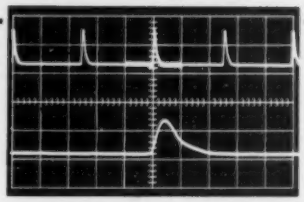
Serving the
electronics industry
— in management,
research, design and application

481 University Avenue, Toronto

CANADIAN ELECTRONICS ENGINEERING

A MACLEAN-HUNTER PUBLICATION

NEW DC-to-30 MC
DUAL-BEAM Oscilloscope
with Calibrated Sweep Delay
TYPE 555



SWEEP DELAY
Simultaneous display of pulse ci.ain (upper beam) and third pulse on expanded delayed sweep (lower beam). Portion of original display that appears on faster delayed sweep is identified by trace brightening.

Two electron beams, each with its own X and Y deflection plates, help make possible a highly versatile dual-beam oscilloscope. Either of the two time-base generators in the Type 555 can deflect either beam for dual and single displays, and either can deflect both beams for a dual display on the same time base.

With one time-base generator functioning as a delay generator, the start of any sweep generated by the other can be held off for a selected time interval with a high degree of accuracy. Both the original display and the delayed display can be observed at the same time. The "triggered" feature can be used to obtain a jitter-free display of signals with inherent jitter.

Signal-handling versatility is provided by nine available types of plug-in preamplifiers, any combination of which can be used in the two fast-rise vertical channels. In addition to the many application areas opened with Tektronix plug-in preamplifiers, a three-channel or four-channel display is available through use of the time-sharing characteristics of Type C-A Dual-Trace Units in one or both channels.

Please call your Tektronix Field Engineer or Representative for complete specifications.

Characteristics

INDEPENDENT ELECTRON BEAMS
Separate vertical and horizontal deflection of both beams.

FAST-RISE MAIN VERTICAL AMPLIFIERS
Passbands—dc-to-30 mc with Type K Units.
Risetimes—12 mμsec with Type K Units.
All Tektronix Plug-In Preamplifiers can be used in both vertical channels for signal-handling versatility.

WIDE-RANGE TIME-BASE GENERATORS
Either time-base generator can be used to deflect either or both beams.
Sweep ranges—0.1 μsec/cm to 12 sec/cm. 5 x magnifiers increase calibrated sweep rates to 0.02 μsec/cm.

SWEEP DELAY—Two modes of operation.
Triggered—Delayed sweep started by signal under observation.
Conventional—Delayed sweep started by delayed trigger.
Delay range—0.5 μsec to 50 sec in 24 calibrated steps, with continuous calibrated adjustment between steps.

HIGH WRITING RATE
10-KV Accelerating potential provides bright traces at low repetition rates and in one-shot application.

REGULATED POWER SUPPLY

PRICE, Type 555 without plug-in preamplifiers . . . **$2700**
Includes Indicator Unit, Power Supply Unit, Scope-Mobile, 4—10 x atten. probes.
Price f.o.b. factory

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon
Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

Tektronix manufactures seventeen other laboratory oscilloscopes, ten of which are also available as rack-mounting instruments.

CANADIAN FIELD OFFICE:
3 Finch Avenue East, Willowdale, Ontario
Phone: Toronto, BAldwin 5-1138

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THE VICTOREEN INSTRUMENT CO.
(COMPONENTS DIVISION)

Represented Exclusively in Canada by TRIL

GLASS-SEALED DEPOSITED CARBON RESISTORS

RESISTOR DATA CHART

TYPE	RESISTANCE	TOLERANCE	VOLTAGE COEF. % / V	TEMP. COEF. % / °C	MAX. W.V.	WATTAGE	MAX. TEMP. °C	DIMENSIONS A (MAX)	DIMENSIONS B (MAX)	DIMENSIONS C (MIN)
RX2	1 Meg to 50 Meg	1,2,5,10,20 Note 1	—.0002	—0.08	3000	1	125	2	.413	1½
RX3	1 Meg to 200 Meg	1,2,5,10,20 Note 2	—.0002	—0.08	10,000	3	125	3½	.413	1½
RX4	200 ohm to 50 Meg	1,2,5	—.0002	—0.05	800	5	200	2	.413	1½
RX5	200 ohm to 200 Meg	1,2,5 Note 3	—.0002	—0.05	2000	10	200	3½	.413	1½
RX8	100 ohm to 10 Meg	1,2,5	—.0002	—0.05	750	2	200	1½	.240	1⅜

NOTE: 1: 1% and 2% tolerance available only below 20 meg.
2: 1%, 2% and 5% tolerance available only below 100 meg.
3: 1% and 2% tolerance available only below 100 meg.

DIMENSIONS

HI-MEG RESISTORS

GLASS SEAL: HI-MEGS are vacuum sealed in a glass envelope which is treated with a special silicone varnish which keeps the resistor relatively free from the effects of moisture.

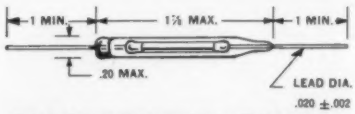
RESISTANCE: HI-MEG resistors are available in values from 10^8 to 10^{14} ohms.

TOLERANCE: HI-MEG resistors can be supplied in the following tolerances: 1% below 10^{12} ohms, 2% and 5% below 10^{13} ohms, and 10% over the entire range.

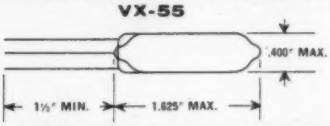
MAXIMUM WORKING VOLTAGE: 1000 volts.

MAXIMUM OPERATING AMBIENT TEMPERATURE: 100° C.

POWER RATING: The power rating for any HI-MEG resistor is equal to one divided by the resistance in megohms.



ELECTROMETER TRIODE
VX-55



TYPICAL OPERATION AND TEST CONDITIONS

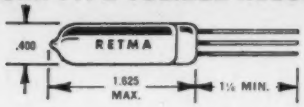
E_f	1.25	Volts
I_f	10.0	ma
E_p	7.5	Volts
E_g	−2.2	Volts
I_p	95	μa
G_m	110	μmho
I_g	5×10^{-14}	amp
M_u	2.1	

ELECTROMETER TETRODE
5800/VX-41A

AS A TETRODE ELECTROMETER

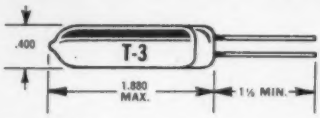
Plate Voltage	+45	Volts
Accelerator Grid Voltage (g_1)	+34	Volts
Control Grid Voltage (g_2)	−3	Volts
Amplification Factor	1	
Transconductance	15	μmhos
Plate Current	12	μa
Accelerator Grid Current	300	μa
Control Grid Current	10^{-13}	Amp

CORONA TYPE VOLTAGE REGULATORS



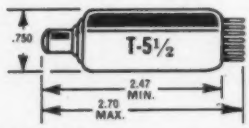
R. E. T. M. A. Types

TYPE	NOM.	TOLERANCE	NOM. TEST PT.	CURRENT IN μa MIN.	CURRENT IN μa MAX.	CURRENT IN μa PEAK	REGULATION VOLTS	REGULATION CURRENT RANGE
5950	700V	± 15V	25μa	5	100	150	14V	5-100μa
5841	900V	± 18V	25μa	5	100	150	18V	5-100μa
6143	1200V	± 24V	25μa	10	100	150	24V	5-100μa
6119	2000V	±100V	25μa	15	100	150	40V	5-100μa



Commonly Used Models in T-3 Size*

TYPE	NOM. TEST PT.	TOLERANCE	NOM.	CURRENT IN μa MIN.	CURRENT IN μa MAX.	CURRENT IN μa PEAK	REGULATION VOLTS	REGULATION CURRENT RANGE
GV3B-400	50μa	±10V	400V	5	150	300	15V	5-150μa
GV3B-500	50μa	±10V	500V	5	150	250	15V	5-150μa
GV3B-600	50μa	±10V	600V	5	150	300	20V	5-150μa
GV3B-700	50μa	±15V	700V	5	150	300	20V	5-150μa
GV3B-800	50μa	±15V	800V	5	150	300	20V	5-150μa
GV3A-900	50μa	±15V	900V	10	250	350	25V	10-250μa
GV3A-1000	50μa	±20V	1000V	10	250	350	30V	10-250μa
GV3A-1200	50μa	±30V	1200V	10	250	400	40V	10-250μa
GV3A-1500	50μa	±30V	1500V	15	300	500	50V	15-300μa
GV3A-1800	50μa	±40V	1800V	15	300	500	65V	15-300μa
GV3A-2000	50μa	±50V	2000V	15	300	500	75V	15-300μa



Commonly Used Models in T-5½ Size*

TYPE	NOM.	TOLERANCE	NOM. TEST PT.	CURRENT IN μa MIN.	CURRENT IN μa MAX.	CURRENT IN μa PEAK	REGULATION VOLTS	REGULATION CURRENT RANGE
GV5B-700	700V	± 20V	100μa	10	250	350	25V	10-250μa
GV5B-900	900V	± 25V	100μa	10	300	500	30V	10-300μa
GV5B-1000	1000V	± 30V	100μa	10	300	500	35V	10-300μa
GV5A-1200	1200V	± 36V	100μa	10	400	600	40V	10-400μa
GV5A-1600	1600V	± 50V	100μa	15	600	800	40V	15-600μa
GV5A-2200	2200V	± 65V	100μa	20	800	1000	50V	20-800μa
GV5A-2500	2500V	± 75V	100μa	25	1000	1200	60V	25-1000μa
GV5A-3000	3000V	± 90V	100μa	30	1000	1200	75V	30-1000μa
GV5C-4000	4000V	±120V	100μa	30	400	1000	45V	30-400μa
GV5C-5000	5000V	±150V	100μa	30	400	1000	70V	30-400μa

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TRIL Stocks World Famous VICTOREEN Components for immediate delivery at Factory Prices.

Detailed Specifications and price information on the items listed here and other Victoreen Components available on request. Write today.

TRIL WORLD WIDE SERVICE

TERMINAL RADIO INTERNATIONAL LTD.
135 Liberty Street, New York 6, N. Y., U. S. A. • Phone WOrth 4-3373

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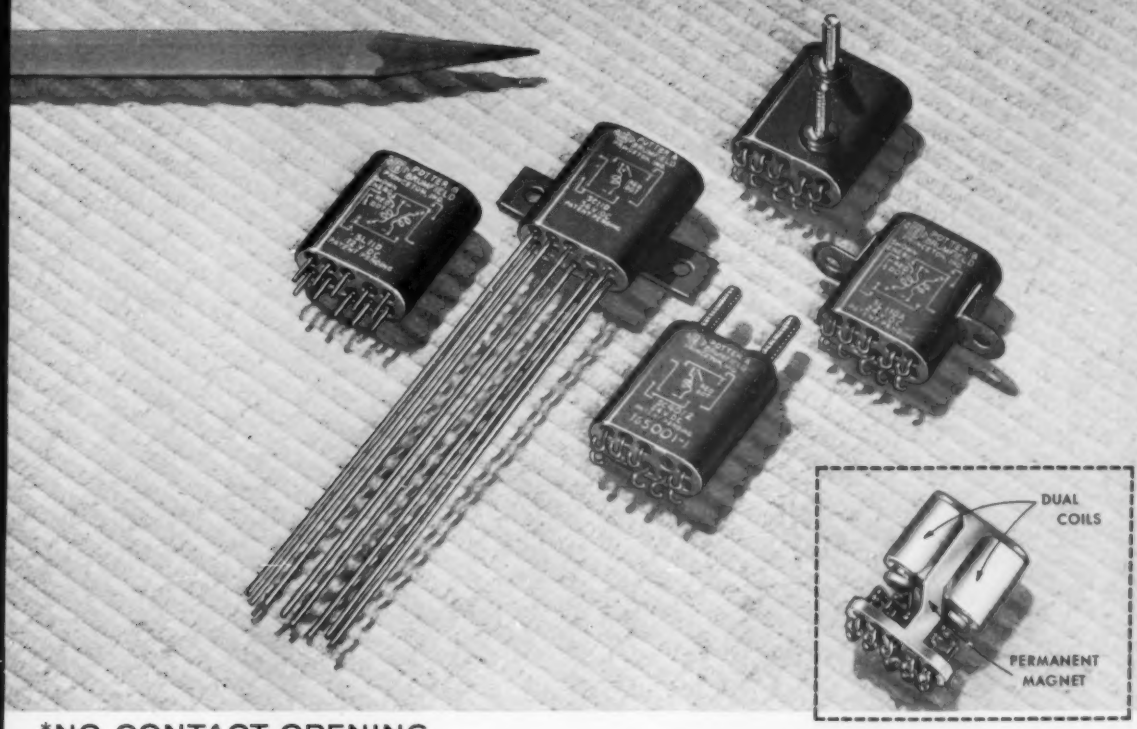
P&B MICRO-MINIATURE RELAYS LEAD IN

performance

SHOCK: 100g* VIBRATION: 30g to 2000 cps*

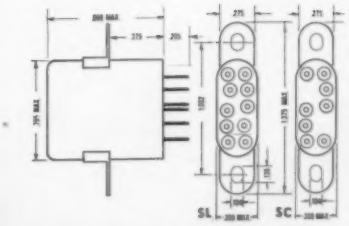


*NO CONTACT OPENING

New P&B crystal-case size relays, the SC and the SL (magnetic latching), show amazing shock and vibration capabilities. They absorb shocks of 100g and vibrations 30g to 2000 cps. without contact openings!

A highly efficient magnetic structure utilizing a permanent magnet makes possible at least twice the contact pressure found in DPDT relays of comparable size. One watt of power for three milliseconds operates either relay. Transfer time is unusually fast —0.5 milliseconds maximum.

For more information, contact your P&B sales engineer, or write Potter & Brumfield, Princeton, Indiana.



SL—dual coil latching relay. Operates on a 1 watt, 3 ms. pulse at nominal voltage. Permanent magnet latch locks the armature in either position.

SC—non-latching relay with series-connected dual coils. Operates on approximately 1 watt at nominal voltage. Coils must remain energized to hold the armature in the operate position.

SC and SL Series Engineering Data

GENERAL:
Insulation Resistance: 10,000 megohms, min.
Breakdown Voltage: 1,000 V. RMS.
Shock: 100g.
Vibration: 30g 55 to 2000 cps.; 0.195" max. excursions from 10-55 cps.
Temperature Range: —65° C. to + 125° C.
Weight: 15 grams without mounting bracket.
Operate Time: 3 MS. max. with 550 ohm coil @ 24 V. DC. (SL: 630 ohm coil at 24 V. DC).
Transfer Time: 0.5 MS max.
Terminals: (1) Plug-in for microminiature receptacle of printed circuit board. (2) Hook end solder for 2 #24 AWG wires. (3) 3" flexible leads.
Enclosure: Hermetically sealed.

CONTACTS:
Arrangement: 2 Form C.
Material: Optional
Load: 2 amps. @ 28 V. DC, resistive; 1 amp @ 115 V. 60 cycles AC, resistive.
Pressure: SC—16 grams min.; SL—20 grams min.

COIL:
Power: Approx. 1.0 watt at Nominal Voltage.
Resistance: SL—40 to 10,000 ohms; SC—35 to 20,000 ohms.
Duty: Continuous.

MOUNTINGS:
Bracket, stud and plug-in.

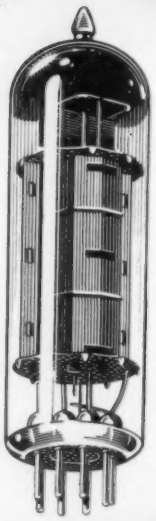
P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

POTTER & BRUMFIELD CANADA LTD.
GUELPH, ONTARIO

The Rogers 6BQ5 Pentode for High Quality Amplifiers and Receivers Produced in volume in Canada, under Rogers High Quality Control Standards, the Rogers 6BQ5 has won acceptance by Equipment Manufacturers in Canada and abroad. It is a 12 watt dissipation pentode which provides high peak power of up to 17 watts output with very low distortion (4%).

The Rogers 6BQ5 (the world famous EL84) has been designed for two prime applications—as a sound output tube in high fidelity amplifiers and high quality television receivers; as a vertical output tube where special factory tests ensure good linearity and high zero-bias plate knee current.

Rogers wide range of quality industrial tubes are finding more applications in all types of professional equipment. For greater reliability and lower maintenance costs, specify Rogers tubes.



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electronic tubes & components

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AVAILABLE NOW

The new MODEL '270'

A custom instrument in the Simpson "260" tradition

- Increased accuracy
- Human engineered scales
- Movement overload protection - and a host of other attractive features for discriminating users.

For those who for years have valued the reliability and versatility of the Simpson "260", the Custom-Engineered Model 270 offers a multitude of new features for applications calling for a higher order of accuracy, with no sacrifice in the qualities which have made the "260" famous the world over.

Ranges and scale layouts have been designed for maximum readability with an anti-parallax mirror and knife edge pointer. Precision components and calibration techniques assure accuracies down to ± 1.25% on most of the D.C. ranges, with similar accuracy improvements on other ranges. In addition, the operating manual specifies accuracies on all ranges for a variety of operating conditions, frequency correction curves and a host of useful information.

To conserve this high order of accuracy, a circuit fuse and meter current-limiting diode guard against accidental overload, over and above that provided for in the choice of rugged and generously rated components.

Truly a Custom-Engineered instrument to suit the present day trend to greater precision in measurement.

Write for further details

Price — $62.50, Sales Tax Included

The Canadian-made Simpson 260 will continue to be available
Price: $54.50

Bach-Simpson LIMITED

1255 Brydges St. London

IN U.S.A.—SIMPSON ELECTRIC COMPANY, 5200 W. KINZIE STREET, CHICAGO 44, ILL.

J-9331

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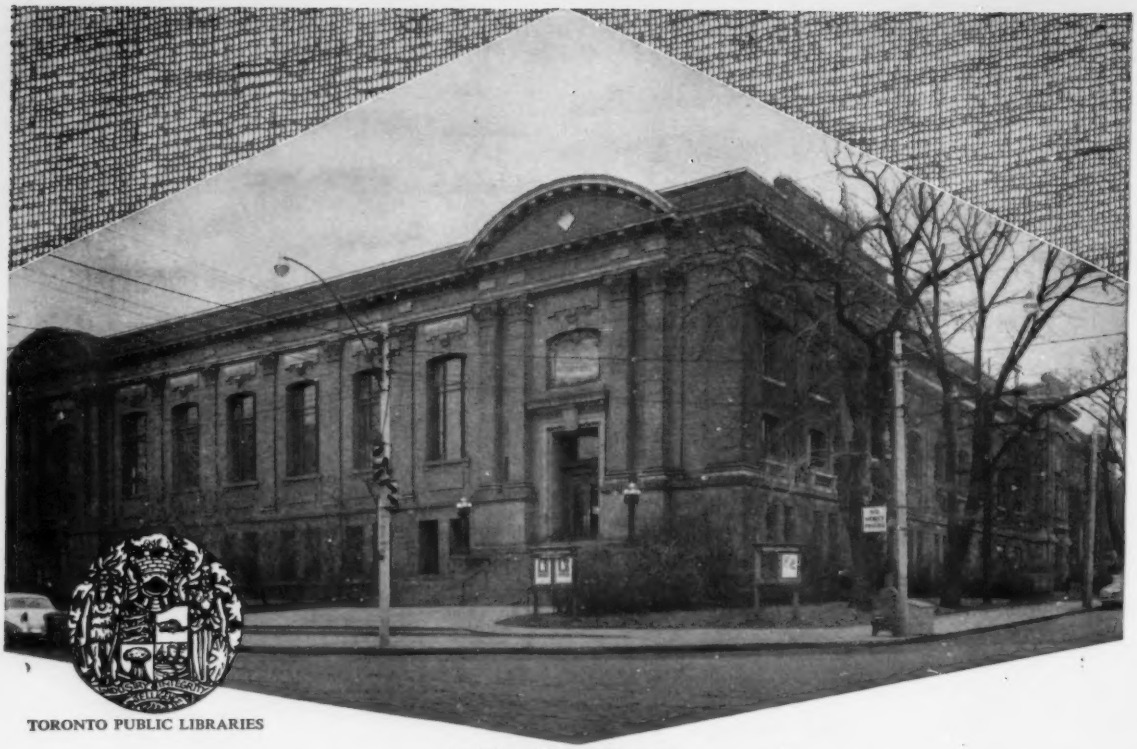

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Last year 58,000 people used The Hallam Room at the Toronto Public Library. On file there are issues of several hundred Canadian business papers and house organs. A survey of 6000 firms in Toronto showed 45% consult the library 1 to 5 times a year and over 75% of the information they want is found in business and trade publications. The story is much the same in most large Canadian libraries.

The McGill University Library School Documentation Seminar 1958 stated: "The pre-eminent position given to business publications has long been recognized . . . libraries have for many years devoted attention to providing the widest access to business publications".

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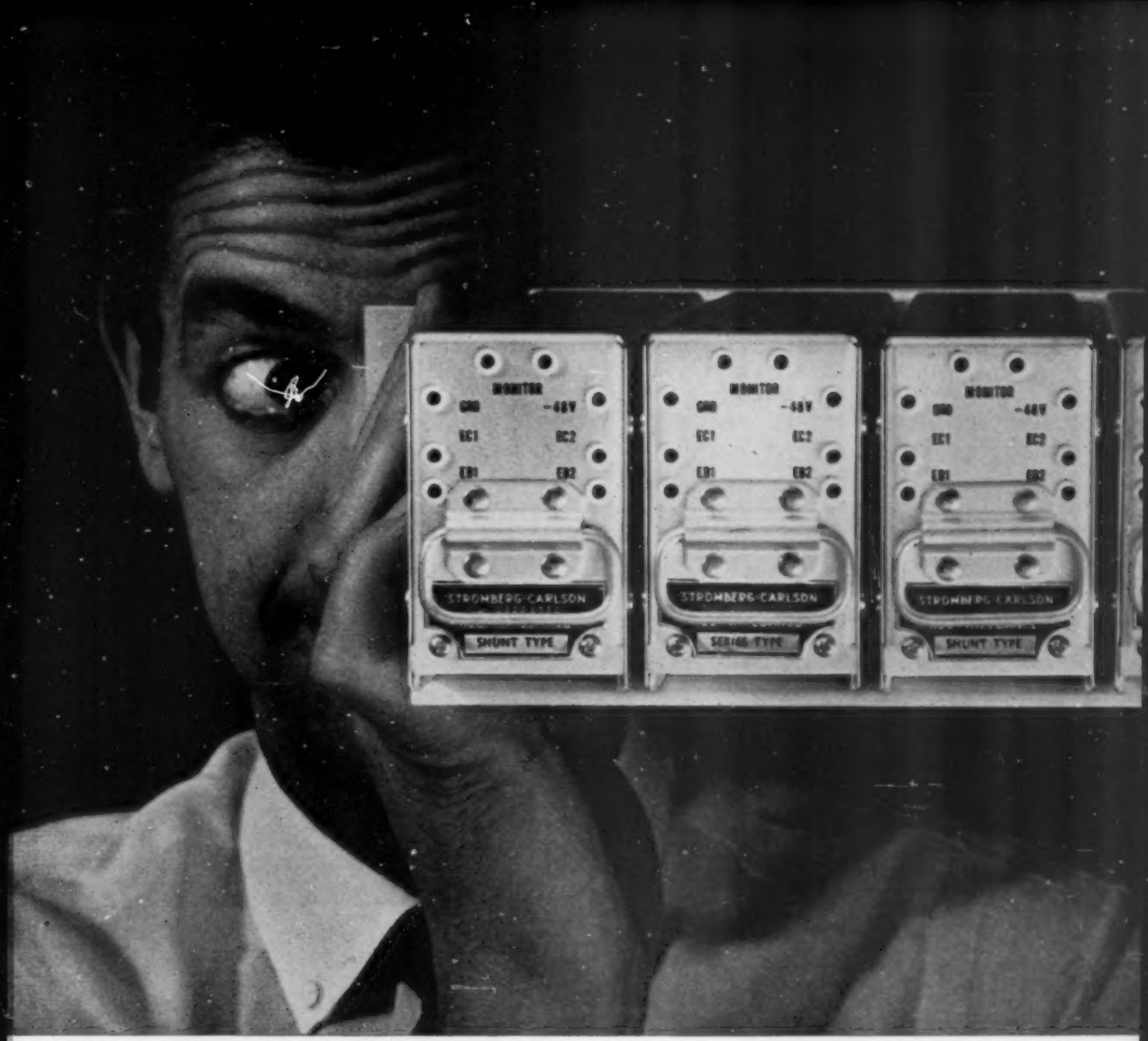

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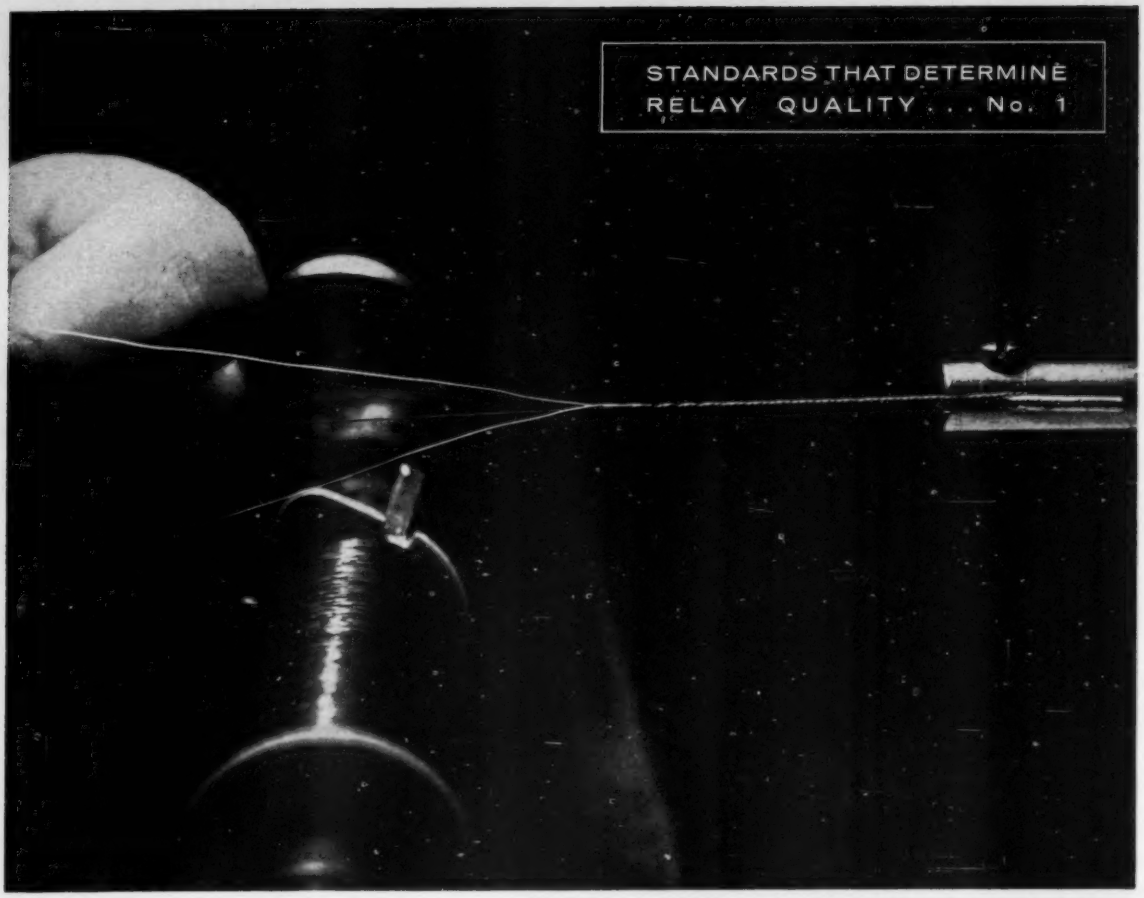

Solderless splice solves problem of open coil windings

trouble-free coil windings

Solderless splice ends failures two ways

The two chief causes of relay coil windings going open in service are: (1) electrolysis, and (2) breaking at the terminal. Automatic Electric prevents these difficulties with a winding termination technique that is vitally different.

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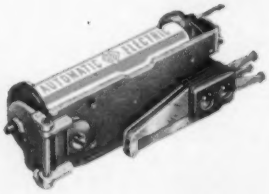
In every step of relay design and manufacture, Automatic Electric take extra pains to prevent trouble before it starts.



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You must get out and sell

Things seem to have started moving during the past few weeks on the placing of defense contracts with Canadian industry, but a lot of aggressive salesmanship by our companies will be needed if we are to keep them coming.

Recent successes by electronics firms include the receipt of the following contracts:
Canadian General Electric Co. Ltd. — development of a drive unit for the FPS7 heavy radar — value $500,000.
Canadian Westinghouse Co. Ltd. — tropospheric scatter communication equipment for the Bomarc interceptor missile program — $1.6 million.
Ferranti-Packard Electric Ltd. — tape readers, subcontract from Hughes Aircraft Corp. — $1.1 million.
Varian Associates of Canada Ltd. — two contracts for klystrons, placed by Bendix — $300,000 total.

In addition to these U. S. contracts, Canadian Westinghouse have received an order from the Royal Navy for 500 Mark 43 homing torpedoes. It is believed that this is the first time that the United Kingdom has placed a peacetime contract for military equipment with a Canadian concern. Canadian General Electric also has the $9 million USAF contract for height-finding radars reported in our last issue.

The Department of Defence Production is doing its utmost in liaison with U. S. officials, not only from its Ottawa headquarters, but also through Washington, New York and Rome, N.Y. representatives. Tours have been arranged of Canadian plants by teams from U. S. prime contractors such as Hughes, Bendix, I.B.M. and Burroughs. Reciprocal visits by representatives of Canadian companies have been made to U. S. firms engaged on the SAGE program, and to U. S. government agencies.

The secret of obtaining further business in any quantity, however, lies in the hands of Canadian companies to a great extent. Not only should they use the services of DDP as much as posible, but they must actively seek out opportunities for themselves.

One authority has suggested that active, full-time representation in Washington is essential in view of the system used in placing contracts by some agencies. Bids are often called for within 30 days on specifications that might easily take two to three times as long to study fully and prepare a comprehensive tender. It is therefore vital to learn in advance by personal contact (with DDP approval) of pending bid requests.

Of course, a prime requisite is that the Canadian company has filed a complete description of its facilities and achievements with the appropriate agencies. It is also extremely useful to have presented this information to the prime contractors who are most likely to be in a position to place appropriate subcontracts. Here again, DDP can be of great assistance.

In general, the best chance of success will fall to those Canadian companies that help themselves best.

The Editor

In the type OJ medium haul carrier telephone system, plug-in units have been used to provide versatility.

Medium haul carrier equipment meets DDD requirements

A. R. HARPER*

The type OJ carrier telephone system is an open wire system developed in Canada for a grade of transmission consistent with direct distance dialing requirements on circuits up to 500 miles in length. For versatility it utilizes plug-in circuits.

With the great improvements which have taken place in telephone systems during the postwar years and the many changes resulting from the introduction of miniaturized components, a great deal of development has, of necessity, been going on in the telephone carrier field.

In the Type "O" carrier equipment, a family developed by the Bell Telephone Laboratories, and consisting, in the main, of a multitude of plug-in units, suitably mounted and connected, full advantage has been taken of all the research and development which has taken place during the past two decades.

The Type "O" family has one very great inherent advantage which its predecessors did not share. A characteristic of its "plug-in" method of assembly is that by means of minor adjustments and substitution of the different component units, a number of systems can conveniently be designed and built up to serve a variety of different needs. Type "OJ" is one of these systems; it is the design which has been developed by Northern Electric for "medium haul" requirements on open wire circuits in Canada. It meets those rigid quality requirements of the Type "J" carrier system, consistent with the standards of the nationwide "direct distance dialling network," which requires as many as eight circuits in tandem on switched connections. The channel bandwidth is 250 to 3,000 cps betweeen 3 db points on message circuits and extends to 3,500 cps for telegraph and special services.

Type "OJ" is a 12-channel open wire system and is capable of installation on and operation over the same pole line as Type "J" and the same wires as Types "OA", "C" or similar systems.

The range of the initial short haul Type "O" systems, "OA", "OB", "OC" and "OD", provides a total of 16 channels in the frequency band from voice frequency to 156 kc. The new medium haul Type "OJ" provides 12 channels in the frequency band 40-148 kc, and can be placed on the same wires as a Type "OA" system to provide 16 channels. While the equipment has a twelve-channel upper limit at the present time, for normal open wire use, 24- and 48-channel radio multiplexing equipment has already passed the development stage. The only change necessary for transmission of 24 channels over radio links is an additional modulation of one 12-channel group. This is necessary in order that two 12-channel systems may be combined for operation on one radio channel.

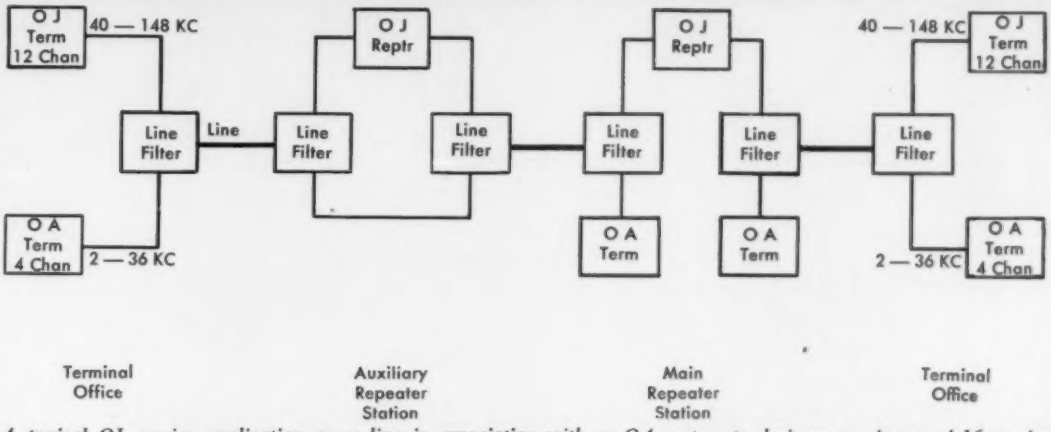
Type "OJ" carrier system is intended, as already stated, for a maximum capacity of 12 channels, but as a result of its being built up from a number of interchangeable components it can be supplied with equipment for only four channels or to suit intermediate requirements.

Equipment for 12 channels is assembled in three groups of four, but may be supplied, initially or by extension, to provide 4, 6, 8, 10 or 12. Channels 1 and 2 in Group No. 1 and 11 and 12 in Group No. 3 represent the minimum initial installation if the necessary pilots and alarm restoration features are to be incorporated.

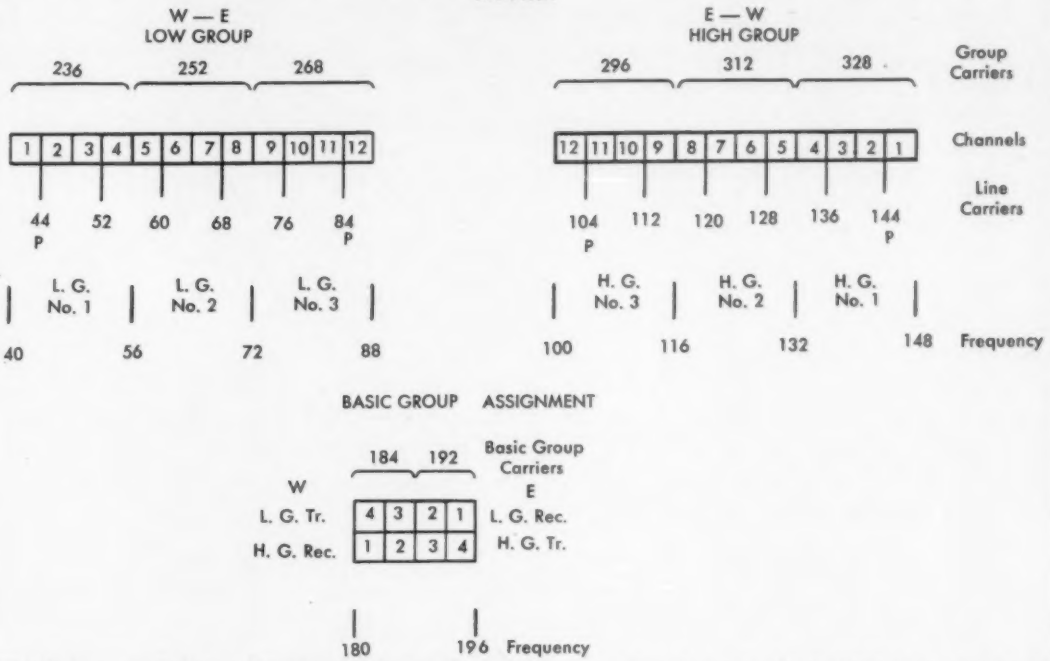
The remaining channels, 3 and 4 in Group No. 1 and 9 and 10 in Group No. 3 can be added as pairs to furnish six and eight channels, while Group No. 2, equipped in pairs also, with channels 5, 6, 7 and 8, is supplied when ten and twelve channels are required.

By using the built-in compandors in the channel units for message circuits, the need for staggering, inversion or frequency frogging is eliminated. There is provision for omitting both compandor and signaling units for telegraph and for special services such as data transmission (SAGE

*Northern Electric Co. Ltd., Montreal.



A typical OJ carrier application on a line in association with an OA system to derive a maximum of 16 carrier channels.



The frequency allocation. OJ is an equivalent four-wire system; a low frequency band, 40-88 kc is transmitted in W-E direction, while a higher frequency band, 100 - 148 kc is transmitted in the E-W direction.

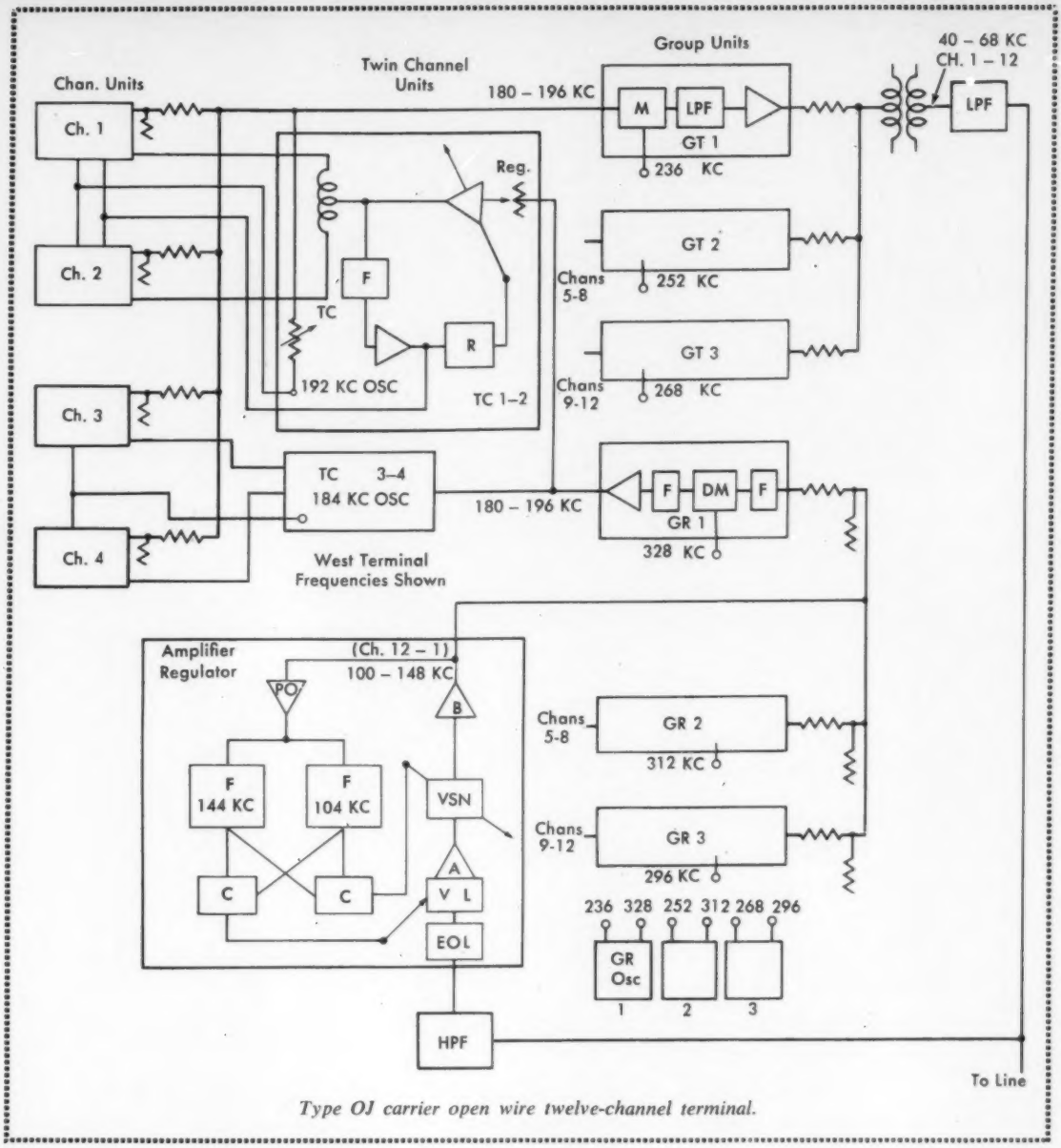
requirements.) Compandors consist of compressors in the transmitting side of each channel unit with corresponding expandors at the receiving end of the channel.

Component apparatus on the plug-in units is assembled on die-cast aluminum chassis. As a result, all apparatus is readily accessible for maintenance, whether in an "in" or "out of service" position. The shelves on which the units are assembled are themselves a part of the mountings which are equipped with the necessary alarm circuits, warning lamps and power supplies.

Another built-in feature is the signal and alarm system. Signaling is operated with a 3,700 cps tone on each channel, generated by an oscillator common to each 4-channel group. The tone is transmitted over each channel during idle periods and is interrupted by an off-hook signal over the M lead. The tone is picked up at the receiving end, converted to dc signals and transmitted via the E lead over the corresponding trunk circuit. Dial pulses are similarly transmitted. When channels of two systems are component links in a single message circuit and in case of ringdown operations, modifications in signaling methods are effected. Signal equipment may be arranged to provide the following facilities: dial signaling with supervision, re-ring, ringdown, signaling or no signaling.

A terminal alarm device, the function of which indicates at either terminal a failure at the other end of the line, also provides visual indication of the cause of trouble. It initiates and operates an automatic disconnect and busy signal on all E leads whenever a breakdown occurs.

It will be appreciated that equipment of this nature calls for the minimum of skill in both installation and maintenance, since it is a simple matter to locate a defec-



Type OJ carrier open wire twelve-channel terminal.

tive unit which can be removed and reassembled with the use of the simplest tools, while repair can be effected by skilled help at the repair centre of the telephone company.

"OJ" carrier terminals are designed to operate from —48 volt and +130 volt dc supplies, while the repeater may be operated from the +130 volt supply only. The amount of current required at each voltage is shown in table 1.

Three 4-channel terminals are mounted in each terminal bay with an amplifier-regulator and an optional jack field containing the patching jacks for the twelve channels. Each amplifier-regulator circuit provides both flat and slope regulations for a complete 12-channel group of 40-88 kc in the W-E direction or 100-148 kc in the E-W direction. One of these circuits is employed as a receiving unit at each terminal while two units serve as the two halves of the repeater.

Equipment	—48 volts	+130 volts
Terminal	5 amps.	1.4 amps.
Repeater operated on —48v. and + 130 v.	1.5 amps.	0.3 amps.
Repeater operated on + 130 v. only	——	1.7 amps.

Table 1.

(Continued on page 28)

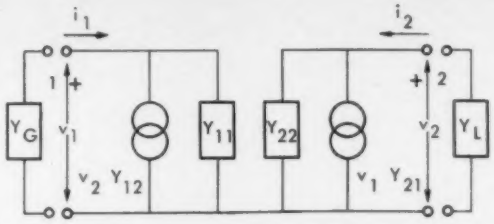


Fig. 1. 4-terminal, 2-generator admittance circuit.

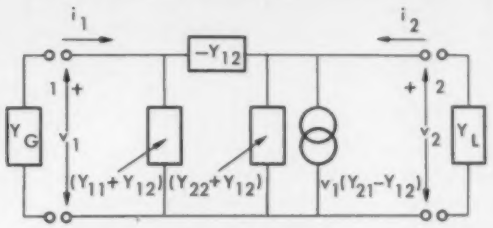


Fig. 2. 4-terminal, 1-generator admittance circuit.

The transistor as a 4-terminal network

M. A. GULLEN, P.ENG*

Construction of simple straight line or circular curves, derived from the admittance parameters of a quadripole, yields information on the stability, current, voltage and power gain characteristics of the network with respect to all terminal admittances at any one frequency. Details of curve construction are given and illustrated by application to a transistor.

Part 1: Basic analysis

The design, or analysis, of a circuit requires the representation of any active element by an electrical network. With pentode tubes, a simple two or four component equivalent circuit is normally acceptable. Each component is the analogue of a specific region or electrode. Together they provide an approximate characterization of the tube. If, however, the frequency of operation is some hundreds of megacycles per second, additional components must be added to include the effects of cathode lead inductance, transit time and grid to plate feedback coupling. Such additions extend the validity of the equivalent circuit over a broad frequency band, but increase considerably the difficulties of mathematical manipulation. Retention of the analogue approach at higher frequencies is of doubtful value, particularly if interest is confined to a narrow frequency band, the number of components introduced exceeds eight or if any component is not susceptible to easy measurement.

With transistors, the frequency at which frequency effects become significant is lower by some one hundred times when compared to tubes. This arises from the relatively long transit time of carriers in the base region and from the greater inherent input-output feedback. To this time, no means of fitting the equivalent of a screen grid to a semiconductor triode has been found. The increasing demand to build high frequency circuits around a transistor has stimulated interest in the theory of four terminal networks or quadripoles. The quadripole approach provides an alternative, parametric method of characterization, accurate over any narrow frequency band, which is applicable to an active element, passive network, or combinations thereof.

*Army Development Establishment, Ottawa.

The admittance parameters

Consider a general four terminal network with two terminals defined as the input terminals, two as the output terminals. With each pair there is a related voltage and current, giving four variables. The network is assumed to be such that if the values of two of these variables are fixed the values of the remaining two are uniquely determined. Two items in four have six combinations, giving six possible similar parametric sets. Three have found popular acceptance: the admittance, impedance and hybrid sets. Using the admittance set, the input and output currents, i_1 and i_2, are taken as functions of the input and output voltages, v_1 and v_2, with

$$i_1 = v_1 Y_{11} + v_2 Y_{12}$$
$$i_2 = v_2 Y_{22} + v_1 Y_{21}$$

Inspection shows that Y_{11} is the input admittance output shorted; Y_{22} is the output admittance, input shorted; Y_{12} is the reverse transfer admittance, input shorted and Y_{21} is the forward transfer admittance, output shorted. Figure 1 is described by the above equations. Elementary analysis shows that they also describe the circuit of Figure 2. These circuits are the general two-generator and one-generator admittance quadripoles respectively.

The transistor admittance parameters are functions of the operating point, that is, collector current and voltage, and of frequency. At a fixed operating point it is found that, for most p-n-p transistors in the common base configuration, the frequency characteristics of Y_{11} and Y_{21} are closely approximated by the admittance of the circuit of Figure 3, while those of Y_{12} and Y_{22} are closely approximated by the circuit of

Figure 4, up to some limiting frequency. N-p-n transistors of silicon and germanium have, to date, been found to require more complex networks to represent their admittance parameters over a broad frequency band.

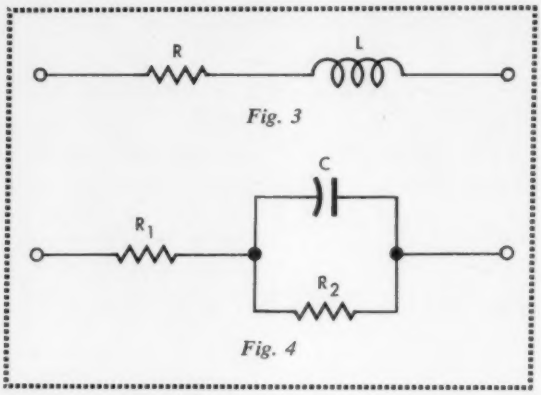


Fig. 3

Fig. 4

Measurements of the admittance parameters require only short-circuit terminations of the network, while the hybrid and impedance sets require two and four open-circuit terminations respectively. A short-circuit is, generally, simpler to obtain at high frequency. Ease of measurement, particularly of the transfer parameters, has encouraged acceptance of the admittance set. The impedance and hybrid sets still find favour in many quarters and have formed the basis of previous analytical discussions. [1,2,3] This paper is directed towards a graphical display of quadripole performance at any one frequency, using the admittance set measured at that frequency, with the transistor as an example of an active quadripole of particular interest.

The one-generator admittance circuit of Figure 2 is familiar as the basic tool for the design of a unilateral, narrow band, high gain, fixed frequency transistor amplifying stage. The vector quantities $+ Y_{12}$, $(Y_{11} + Y_{12})$, $(Y_{22} + Y_{12})$ and the magnitude of $(Y_{21} - Y_{12})$ respectively, answer the designer's questions regarding the neutralizing, or unilateralizing admittance required, the input and output admittance and transconductance of the transistor. Other questions regarding (a) the need for neutralization, (b) the limitations to be imposed on the source and load admittances for stable operation, (c) the possibility of conjugate matching and the attainment of a true maximum power gain, (d) the manner in which the phase and magnitude of current and voltage gain change with load admittance (important in oscillator applications), may, however, be asked.

Graphical displays, involving only circles and straight lines in the load or generator admittance planes readily provide the required information.

In the following, Y_{11} is written as $a_{11} + jb_{11}$, Y_{in} as $a_{in} + jb_{in}$, etc., the product $Y_{12}Y_{21}$ as Y_t or $a_t + jb_t$ and the bracket (Y_t) is used to indicate that magnitude only is considered.

Input and output admittance

If a load Y_L is connected to the output of the circuit of Figure 1, the input admittance Y_{in} is given by

$$Y_{in} = Y_{11} - \frac{Y_{12}Y_{21}}{Y_{22} + Y_L} \quad \ldots\ldots\ldots (1)$$

and similarly, the output admittance with a generator of source admittance Y_g is given by

$$Y_{out} = Y_{22} - \frac{Y_{12}Y_{21}}{Y_{11} + Y_g} \quad \ldots\ldots\ldots (2)$$

Equation (1), after equating real and imaginary parts, shows the locus of constant input conductance, a_{in}, to be a family of circles in the a_L, b_L plane whose centre co-ordinates are

$$-\left[a_{22} + \frac{a_t}{2(a_{in} - a_{11})}\right] \quad \ldots\ldots\ldots (1a)$$

and

$$-\left[b_{22} + \frac{b_t}{2(a_{in} - a_{11})}\right]$$

and whose radii squared are

$$\frac{(Y_t)^2}{4(a_{in} - a_{11})^2} \quad \ldots\ldots\ldots (1b)$$

Similarly a family of circles whose centre co-ordinates are

$$-\left[a_{22} + \frac{b_t}{2(b_{in} - b_{11})^2}\right] \quad \ldots\ldots\ldots (1c)$$

and

$$-\left[b_{22} - \frac{a_t}{2(b_{in} - b_{11})}\right]$$

and whose radii squared are

$$\frac{(Y_t)^2}{4(b_{in} - b_{11})^2} \quad \ldots\ldots\ldots (1d)$$

is obtained by considering b_{in} as a function of a_L and b_L. The centre co-ordinates of (1a) lie on a line

$$b_L = \frac{b_t}{a_t} a_L + \frac{b_t}{a_t} a_{22} - b_{22} \quad \ldots\ldots\ldots (1e)$$

and those of (1c) on a line

$$b_L = -\frac{a_t}{b_t} a_L - \frac{a_t}{b_t} a_{22} - b_{22} \quad \ldots\ldots\ldots (1f)$$

Inspection shows that these two lines of centres in the a_L, b_L plane are orthogonal and their point of intersection is

$$a_L = -a_{22}, \qquad b_L = -b_{22} \quad \ldots\ldots\ldots (1g)$$

Examination of the output admittance, equation (2), along similar lines, shows that two families of circles exist in the a_g, b_g plane; one family, the locus of constant output conductance, with centres at

$$-\left[a_{11} + \frac{a_t}{2(a_{out} - a_{22})}\right], \qquad -\left[b_{11} + \frac{b_t}{2(a_{out} - a_{22})}\right] \quad \ldots\ldots\ldots (2a)$$

and radii squared

$$\frac{(Y_t)^2}{4(a_{out} - a_{22})^2} \quad \ldots\ldots\ldots (2b)$$

and a second family, the locus of constant output susceptance, with centres at

$$-\left[a_{11} + \frac{b_t}{2(b_{out} - b_{22})}\right], \qquad -\left[b_{11} - \frac{a_t}{2(b_{out} - b_{22})}\right] \quad \ldots\ldots\ldots (2c)$$

and radii squared

$$\frac{(Y_t)^2}{4(b_{out} - b_{22})^2} \quad \ldots\ldots\ldots (2d)$$

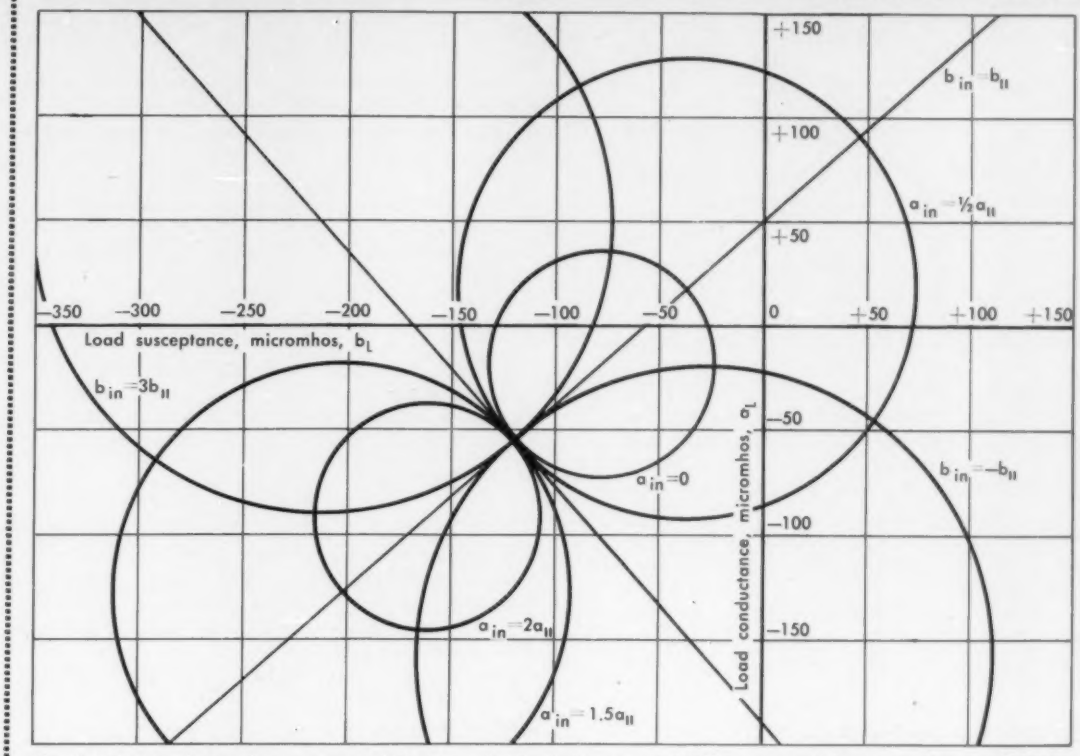


Fig. 5. Curves drawn from measured input — load admittance of 2N123 common base transistors at 398 kc.

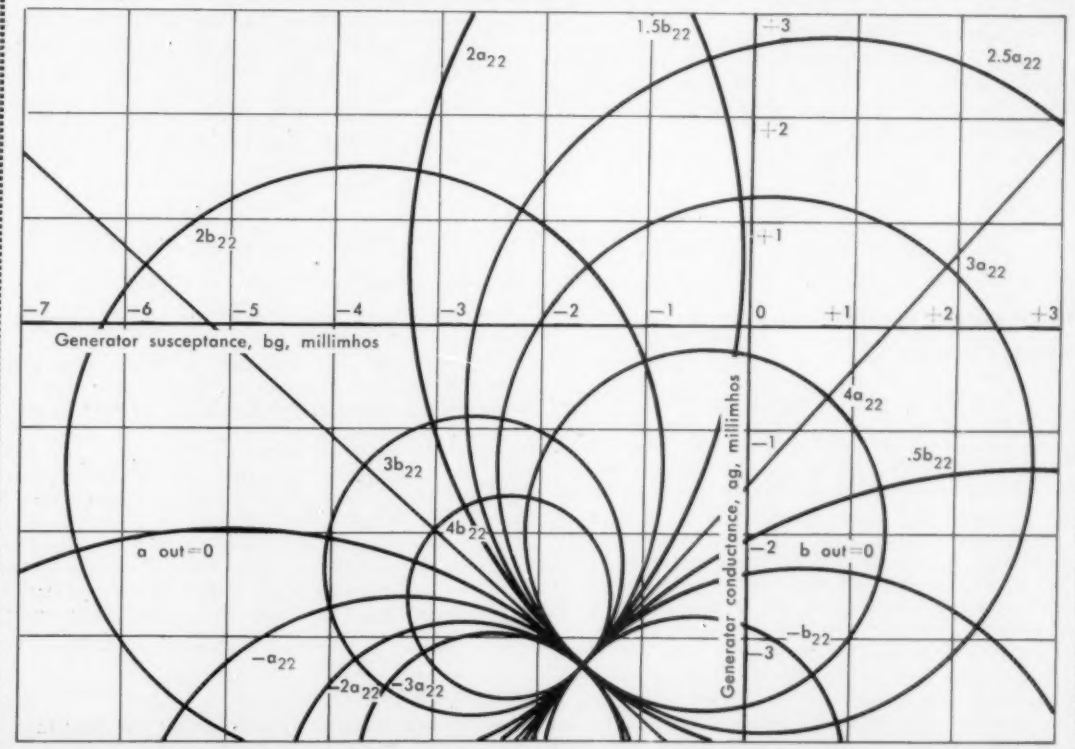


Fig. 6. Curves drawn from measured output-generator admittance of 2N123 common emitter transistors at 1114 kc.

The centre co-ordinates of (2a) lie on a line

$$b_g = \frac{b_t}{a_t} a_g + \frac{b_t}{a_t} a_{11} - b_{11} \quad \ldots\ldots (2e)$$

and those of (2c) on a line

$$b_g = -\frac{a_t}{b_t} a_g - \frac{a_t}{b_t} a_{11} - b_{11} \quad \ldots\ldots (2f)$$

These lines of centres in the a_g, b_g plane are also orthogonal and intersect at the point

$$a_g = -a_{11} \qquad b_g = -b_{11} \quad \ldots\ldots (2g)$$

If the real component of the input admittance, a_{in}, is expressed in terms of a_{11}; and if the susceptive component of the input admittance, b_{in}, is expressed in terms of b_{11}; the above equations provide circles of constant a_{in} and b_{in} against load conductance and susceptance. Similarly if a_{out} is expressed in terms of a_{22} and b_{out} in terms of b_{22}, circles of constant a_{out} and b_{out} against generator conductance and susceptance are obtained. Further, all the circles of constant a_{in} have the line of centres of the circles of constant b_{in} as a common tangent at the point, $-a_{22}$, $-b_{22}$, and, similarly, the constant b_{in} circles have a common tangent in the line of centres of constant a_{in} circles at the same point.

Sample curves constructed from the measured admittance parameters of a 2N123 are shown in Figures 5 and 6. The operating point is 6 volts V_{cb} and 1 ma I_e.

The zero conductance circle

There is a circle corresponding to zero input conductance in the a_L, b_L plane and a similar circle corresponding to zero output conductance in the a_g, b_g plane. If a load admittance, or generator admittance, corresponding to a point within these circles is chosen, the input, or output admittance will have a negative real component.

From (1a) and (1b), the circle corresponding to a zero value of a_{in} has its centre at

$$-\left[a_{22} - \frac{a_t}{2a_{11}}\right], \qquad -\left[b_{22} - \frac{b_t}{2a_{11}}\right] \quad \ldots\ldots (3)$$

and its radius squared is

$$\frac{(Y_t)^2}{4a_{11}^2} \quad \ldots\ldots (4)$$

Similar expressions may be derived for the zero output conductance circle from (2a) and (2b).

The zero input conductance circle intersects the b_L axis at the points

$$b_L = \frac{b_t}{2a_{11}} - b_{22} \pm \sqrt{\frac{a_{22}}{a_{11}}\left(a_t + \frac{b_t^2}{4a_{11}\,a_{22}} - a_{11}\,a_{22}\right)} \quad \ldots (5)$$

The zero output conductance circle intersects the b_g axis at the points

$$b_g = \frac{b_t}{2a_{22}} - b_{11} \pm \sqrt{\frac{a_{11}}{a_{22}}\left(a_t + \frac{b_t^2}{4a_{11}\,a_{22}} - a_{11}\,a_{22}\right)} \quad \ldots (6)$$

The circles also pass through the points $(-a_{22}, -b_{22})$ and $(-a_{11}, -b_{11})$ respectively. The parameters a_{11} and a_{22} are positive for most quadripoles, including the transistor. Hence if the term

$$\left(a_t + \frac{b_t^2}{4a_{11}a_{22}} - a_{11}\,a_{22}\right)$$

is negative, the root term is imaginary and both the zero input and zero output conductance circles are confined to the second and third quadrants of the load and generator planes. There is no region of instability with any positive value of load or generator conductance.

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2. *The Design of Tetrode Transistor Amplifiers, Linvill and Schimpf, Bell System Tech Jour, 35, p 813, July 1956.*
3. *Survey of Some Properties of Linear Networks, Bolinder, IRE Trans Circuit Theory, 4, No 3, p 70, September 1957.*

Part 2 of this article — gain considerations — will be published in the May issue of CEE.

Medium haul carrier equipment

(Continued from page 24)

The outgoing line transmission level in the "OJ" system having been adjusted to divide the compandor advantage between "J" to "OJ" and "OJ" to "J" crosstalk, only 46 db equal level coupling is required between "J" and "OJ" systems on the same pole line and between two "OJ" systems, which are compandored, only 34 db.

The effect of noise may restrict the maximum practicable line section loss in a particular area and hence affect repeater spacing. When an "OJ" system is not engineered on a sleet area basis, it will be desirable to check the layout to estimate the expected noise during wet weather conditions and 1% static.

"OJ" carrier systems may be operated on the same pair of wires with Types "H", "C", "OA" or similar systems using the frequency band below 40 kc, and is compatible with Type "J" and similar systems using the frequency band above 40 kc and operated on the same pole line, provided in both cases that the same repeater spacing and direction of transmission is maintained.

On a line already established for a "J" system, if J5 transpositions have been provided and if pole spacing and wire sag has been arranged to accommodate Type "J" requirements, the same procedure is adhered to when Type "OJ" is added to the line.

The line equipment provides protection against lightning, separation of the frequency bands of carrier systems assigned to the same pair of wires and suppression of noise and crosstalk.

The amount of testing equipment to be provided can be adjusted to customer needs. Requirements at an area servicing centre are naturally greater than at a terminal where no maintenance is carried out except the identification and replacement of a defective plug-in unit.

Acknowledgments

The author wishes to acknowledge the assistance of E. S. Kelsey and T. G. Fellows, members of the scientific staff of the Northern Electric Laboratories, in providing the background information for this article. END

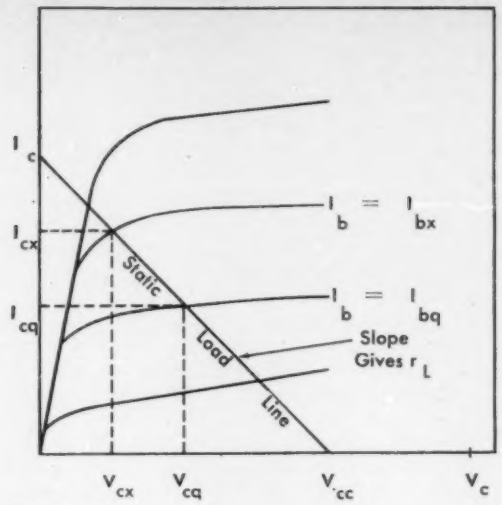

Fig. 1

H. L. ARMSTRONG*

Conventional methods for transistor amplifier design involve the use of "stability factors." This author approaches the problem by considering the allowable shift in the chosen operating point. A sequence of design steps is presented for transistor stages with and without current stabilization.

How to design transistor amplifiers

In the design of transistor amplifiers, one is concerned with establishing a suitable operating point for the transistors—and with controlling, or at least predicting, the way in which the operating points change due to variations in temperature, replacement of transistors, etc. This matter has, of course, been discussed in the literature; however, it seems to the writer that it has often been made more complicated than it needs to be. In particular, the writer feels that the use of "stability factors", which are really instability factors, obscures the main point, which is simply the question, "How much can the operating point be allowed to shift?"

Accordingly, the ways presented here for calculating operating points have been developed. The concepts used are those of "nominal" and "extreme" operating points, which are believed to be more directly related to the ultimate purpose in the design.

The methods are presented as a sequence of design steps, for several circuit configurations. The circuits are assumed to be low-level, capacitor-coupled amplifier stages, but remarks on applying the methods to power amplifier stages, or to transformer coupling, have been included. It has been assumed that extreme conditions come about because of an increase in temperature, so that the extreme operating point represents larger currents than does the nominal; an extreme operating point for lower currents could, of course, be established if there were need. Also, of course, extreme operating points due to variations in transistor properties could be investigated similarly. Usually the extreme operating point is set by the necessity of keeping the collector voltage high enough to avoid distortion, or to maintain the gain. Other requirements, of course, could be handled similarly.

It is assumed that the design will be carried out from a plot of the characteristics of the transistor. Figure 1 shows such a (hypothetical) family of characteristics, along with the operating points, load line, etc. Now the design method will be given.

Amplifier design — general

The requirements of an amplifier can be put into terms of the total current gain required. The current gain (beta or h_{21} or h_f) of the transistors to be used is known. See how many stages, each with that current gain, would be needed. If the figure is marginal, for example, if one wants a current gain of 2000 with two transistors having a beta of 50, it usually is better to add another stage.

The stages are assumed to be capacitor coupled. They may be identical or may have somewhat different operating points. The stages may now be designed according to the following system, whichever of the three kinds of stage seems most desirable, being used.

DESIGN OF OPERATING POINTS

1. No current stabilization. Figure 2.

a. Select a nominal operating point, at collector current I_{cq} and voltage V_{cq}.

b. Find or estimate what I_{cBo} will be at the maximum temperature, or what will be the maximum value if different transistors are used. Find ΔI_{cBo}, the increase in I_{cBo} under extreme conditions. I_{cBo} is the collector-to-base leakage current. It may

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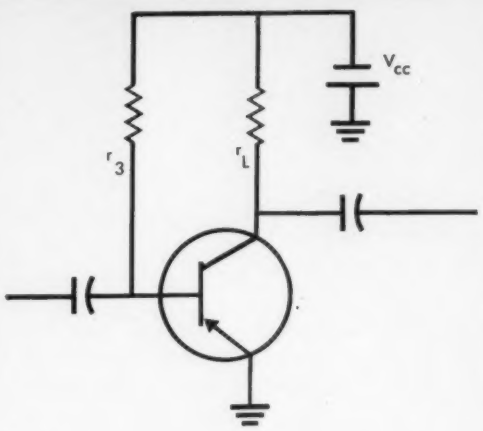


Fig. 2

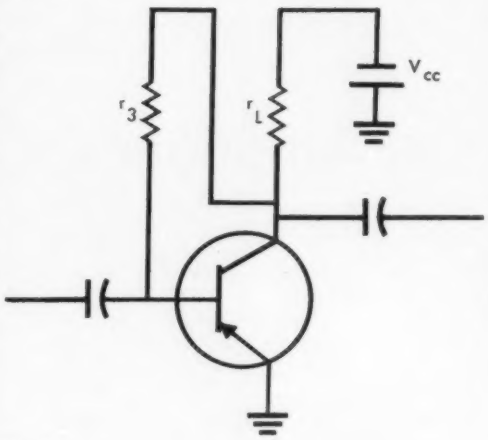


Fig. 3

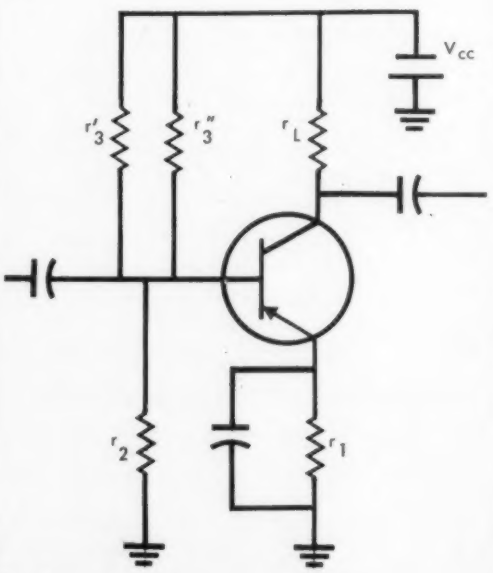


Fig. 4

be specified by the manufacturer as a function of temperature. If it is given only for room temperature, it may be assumed to double for every 10C increase in temperature.

c. Pick the lowest collector voltage at which it would be satisfactory to operate; call it V_{cx}. I_{cx} is the corresponding current.

d. Go along the line $V_c = V_{cx}$ to its intersection with the curve for which $I_b = I_{bq} + \Delta I_{cBo}$; I_{bq} being the base current at the nominal operating point. This will give the extreme operating point at current I_{cx}. (Here $I_b = I_{bx}$).

e. The line joining the nominal operating point and the extreme operating point will have to be the load line; thus its slope determines the load resistance, and its intercept the battery voltage, V_{cc}.

f. When the nominal operating point is chosen, see the base current corresponding to that point. Choose r_3 so that the current which it supplies to the base will just be the base current corresponding to the operating point.

2. Collector-to-base feedback. Figure 3.

a-c. Carry out Sections a-c under Part 1.

d. r_3 will have a value such that, for a voltage drop of V_{cq}, it will pass current I_{bq}. (The base-to-emitter voltage may need to be subtracted from V_{cq} for power transistors; for small transistors this correction will usually be negligible.) If desired, r_3 may consist of two resistors in series, their junction point by-passed to ground by a capacitor whose reactance, at the lowest frequency of interest, is not more than $r_3/10$. This avoids any degeneration of the signal.

e. Go along the line $V_c = V_{cx}$ to its intersection with the curve $I_b = V_{cx}/r_3 + \Delta I_{cBo}$. This intersection will be the extreme operating point at V_{cx} and I_{cx}. (As above, it may be necessary to take V_{cx} minus the base-to-emitter voltage. The latter will be known for power transistors; otherwise, it may be estimated at around 0.1 to 0.2 volts.)

f. The line joining the nominal and extreme operating points will be the load line as before. Thus r_L and V_{cc} are found.

3. Stabilization by a resistor in the emitter circuit. Figure 4.

r_3 is shown divided into r_3' and r_3'' for argument. Note that here, V_c means collector-to-emitter voltage.

a. Choose a nominal operating point.

b. Choose an extreme operating point as before. (For this circuit, I_{cx} can be chosen arbitrarily.)

c. The line joining these two must be the (static) load line; its slope will give the static load resistance; its intercept will give V_{cc}.

d. Choose r_1 as either half the static load resistance, or else such as to produce a drop of one volt for current I_{cq}. Choose whichever value is smaller.

e. Now r_L will be the static load resistance minus r_1.

f. If this does not give a suitable value of r_L, try another nominal, or extreme (or both) operating point.

g. The voltage across r_3'' will be approximately $(V_{cc} - r_1 I_{cq})$. Choose r_3'' such that, for the voltage drop, it will pass current I_{bo}, the base current at the nominal operating point. (Note that $r_1 I_{cq}$ is the voltage across r_1.)

h. Resistors r_3' and r_2 will form a voltage divider, and the voltage across r_2 should be equal to that across r_1. This determines the ratio of r_3' and r_2.

i. As before, the base-to-emitter voltage may be added to that across r_1, if the former is appreciable.

j. At the extreme operating point, the voltage across r_1 will be about $r_1 I_{cx}$. The base current will be I_{bx}, as given by the curve of constant base current passing through the extreme operating point.

k. The voltage divider formed by r_2 and r_3' will look like a generator of internal voltage approximately $r_1 I_{cq}$ and internal resistance equal to r_2 and r_3' in parallel. At the extreme operating point, the voltage at the base will be about $r_1 I_{cx}$. Thus a current equal to that produced by a voltage $r_1(I_{cx} - I_{cq})$ across the resistance of r_2 and r_3' in parallel, will be *subtracted* from the base current at the extreme operating point.

l. There will also be a component of base current equal to that produced by a voltage of $(V_{cc} - r_1 I_{cx})$ across r_3''.

m. Choose the value of r_2 and r_3' in parallel such that ΔI_{cBo}, plus the component of base current found under Section 1., minus the amount subtracted as found under Section k., is equal to I_{bx}. If this should call for an unreasonably low value of this parallel resistance, another selection of operating points may be made.

n. From Section m., and the ratio found under Section h., the values of r_2 and r_3' are found. Combine r_3' and r_3'' into one resistor r_3.

Alternatives

Instead of choosing the extreme operating point, under Section b., one could choose instead the static load resistance, or the value of V_{cc}. Either of these would determine the load line and, if V_{cx} had been chosen, this would determine the extreme operating point. From there, proceed as before.

Values for coupling and by-pass capacitors (if used).

The output resistance of a transistor is usually designated as $1/h_{22}$, which figure is usually supplied on the data sheets. The input resistance is designated as h_{11}. Note that these figures are to be for the common-emitter connection of the transistor; other connections have quite different values. Some manufacturers designate these as h_o and h_i, or give an equivalent circuit from which the information may be obtained. Then the capacitors may be chosen on the following basis.

The output resistance *of a stage* will not be less than the resistance of resistors of value r_L and $1/h_{22}$ in parallel. Assume this value for finding the coupling capacitor; make the reactance of the coupling capacitor at the lowest frequency of interest, not more than one tenth (say) of the output resistance found.

The resistance looking into an emitter will not be less than h_{11}/h_{21}. This is seen as follows. Let the emitter voltage change by ΔV_E. The base changes by the same amount; the base current changes by an amount not more than $\Delta V_E/h_{11}$, and the emitter current by an amount not more than $h_{21}\Delta V_E/H_{11}$. Thus the conductance looking into the emitter is not more than h_{21}/h_{11}.

If an emitter by-pass capacitor is used, it may be chosen so that its reactance, at the lowest frequency concerned, is not more than one-tenth of the resistance just found.

Considerations for emitter followers

The emitter follower is the transistor analogue of the cathode follower, having its load in the emitter circuit. Its features are low output impedance, high input impedance, and approximately unity voltage gain. These emitter followers may be designed on the following principles.

The output resistance will be about that found above, looking into an emitter, for a sufficiently low generator resistance.

The input resistance tends to be about $h_{21}\, r_L$, where r_L is the resistance seen from the emitter. This can be seen since, if the emitter current changes by ΔI_E, the emitter, and thus base, voltages change by about $r_L \Delta I_E$. The base current will change by about $\Delta I_E/h_{21}$; thus the admittance seen at the base is about $1/r_L h_{21}$, and thus the resistance found follows.

There is an effect by which a resistance equal to $1/h_{22}$ appears in parallel with r_L; thus the input resistance can never be more than about h_{21}/h_{22}.

Design the operating point of the emitter follower by any of the methods given, remembering that $r_L = 0$ in the diagrams, so that the collector-to-base feedback method does not help. Remember that one will be concerned with collector-to-emitter voltages here.

MISCELLANEOUS CONSIDERATIONS

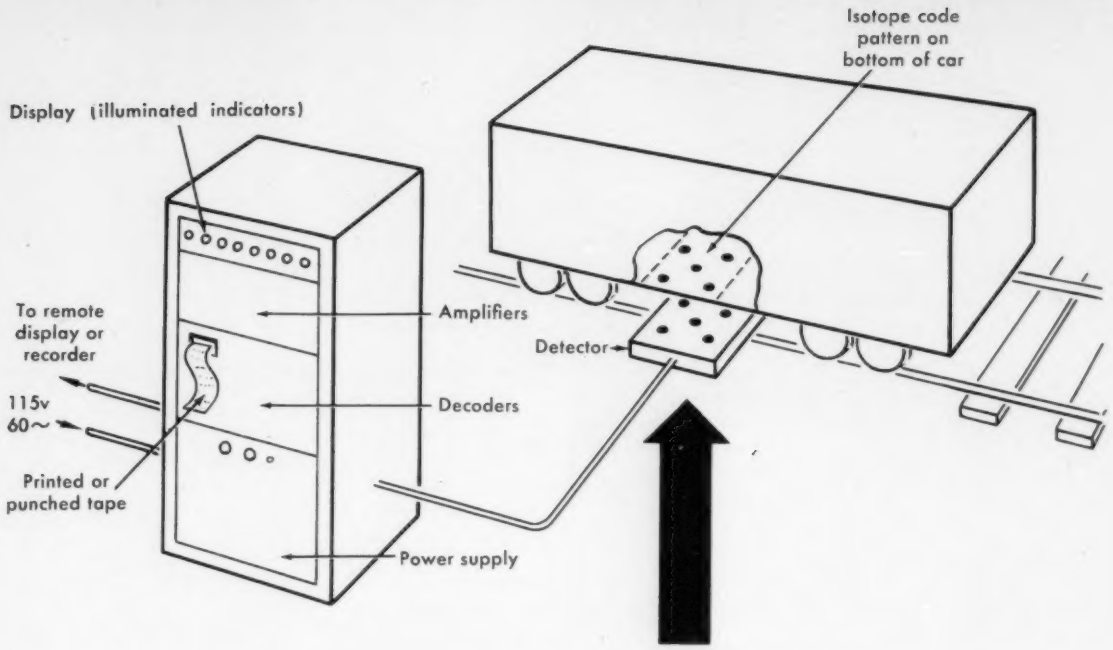
Transformer coupling

Design the operating point as before. A blocking capacitor must be used to keep the base bias current from flowing to ground through the secondary of the input transformer. The current gain, of course, will now include all the current step-up factors. In the methods for the operating point, r_L will be just the DC resistance of a transformer primary winding.

Checking the design of the complete amplifier

Once the amplifier is designed, check to see if the current gain is adequate, taking account of the shunting effect of the bias resistor, etc. Check to see that the signal swing at any transistor will not drive it to excessive distortion.

If the amplifier is suitable in respect of all these matters, the design is complete. If not, it will be necessary to select other operating points. For instance, it might be necessary to go to higher collector voltages to avoid distortion. END



Train cars use radioactive codes to record their movements

IAN R. DUTTON, ASSOCIATE EDITOR

With thousands of box cars and many miles of track, it isn't too difficult to lose a few cars, at least temporarily. In this vehicle identification system radioactive buttons can be attached to the bottom of each car. As it passes over a sensing unit it can provide information on car serial number, time, type of cargo, weight, speed, routing instructions.

The automatic identification of railway rolling stock, transport trucks and in-plant vehicles is becoming more important as traffic density and operating costs increase.

The vehicle identification system (VIS) developed by E. W. Leaver and G. R. Mounce of Electronic Associates Limited, Willowdale, Ontario, utilizes a pattern of radioactive material on each car, and a detection system capable of detecting the pattern and producing information from it which may be stored, displayed or processed according to the needs of the traffic handling system with which it is associated.

In practice, small buttons of radioactive material are arranged in a pattern below each car. It is quite easy to adapt these to fit any type of vehicle and the buttons may be arranged to denote the car serial number, contents, or other information.

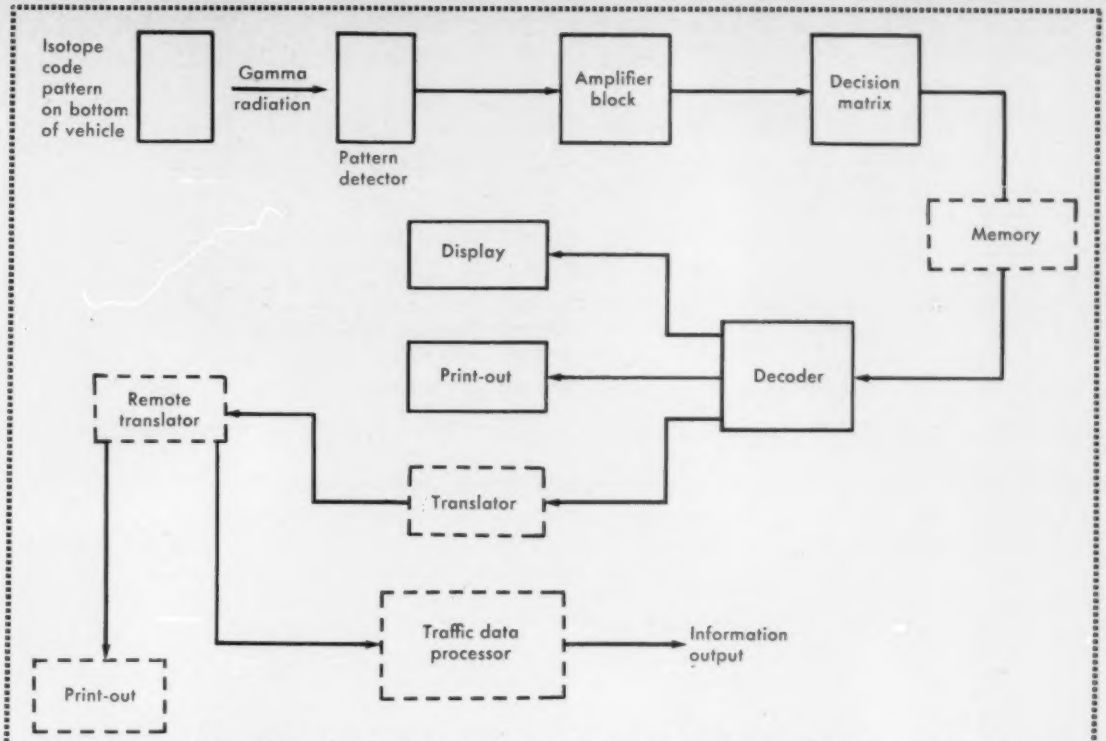
The pick-up located between the railway tracks can sense the pattern of gamma radiation emanating from the car and produce an unique signal for each different pattern. The signal is amplified an dapplied to a matrix which may contain memory elements. It may then be decoded and displayed, printed out, or transmitted to further elements in the traffic control system.

The system has been designed to provide eight digits of information, but this can be increased or decreased to suit specific requirements. By the proper spacing of the radioactive material, and choice of sensing unit, it is possible to make positive identification of vehicles moving in excess of 100 miles per hour.

Due to the use of the gamma radiation, no power is required on the car. Rain, snow or mud will not interfere with operation of the system, and it is not dependent upon having daylight or artificial light available.

VIS presents no radiation hazard.

Wherever radioactive materials are used, proper safety precautions must be observed. However, it is important



Block diagram of the vehicle identification system. Remote indicating and data processing equipment can be used.

that the hazards should not be overrated, or we will deny ourselves the benefits of a large number of valuable applications, many of which can be performed in no other way.

On the other hand, the radiation material must be handled properly, and equipment designed with the right safety features.

There are two general hazards involved. Where small amounts of radioactive material are used, ingestion usually is the more serious; contamination is the other hazard.

In VIS, gas is used as the radioactive material. Ingestion and contamination are impossible, even if the containers are broken, or develop leaks as the result of a major accident involving the vehicle.

VIS permits centralized control.

One advantage of this type of control system is that it removes human observation and recording. The signal output can be utilized locally, or transmitted to a central control point for complete supervision of an entire system such as a transcontinental railway.

Apart from identifying individual railway cars, VIS can be used to provide information on net and gross weight of cars, nature of contents, speed of vehicle, time of arrival or departure, special routing instructions, etc. Removable panels would permit the appropriate coded information to be attached to the vehicle.

VIS can be adapted to any transportation or material handling system using vehicles. The information derived may be fed into data processing systems for traffic direction and for accounting purposes. END

Support your cancer society

The 1959 campaign of the Canadian Cancer Society will be held during April which has been officially designated "Cancer Control Month in Canada."

The campaign slogan is . . . "Fight Cancer with a Check-up and a Cheque," and the national objective is $2,750,000.

A large share of this money will be used to support an extensive cancer research programme under the direction of the National Cancer Institute of Canada. The programme, which involves more than eighty projects, has increased remarkably over the past years and has gained for Canada an enviable reputation in this field. As more trained people and more facilities become available the programme is expanding, and calls for a corresponding increase in public support.

Besides supporting research the Society conducts an extensive education programme and provides assistance to cancer patients.

You can do your share in the fight against cancer by making a generous contribution to the Canadian Cancer Society.

PHOTOS BY FRAZER

Environmental laboratory equipment for humidity, low and high temperature, rotational life and high altitude tests.

Company profile

Precision Electronic Components Ltd.

HAROLD PRICE, EDITOR

Many glowing statements have been made about the future role of the electronics industry in Canada's overall economy. Inspired by faith in that future, a number of people have started new companies and applied initiative and hard work to ensure their success. This is the first in a series of company profiles that will tell the story of some of these new companies

Established in 1950 in Granby, Quebec, Precision Electronic Components Ltd. is a good example of how wise product planning is an essential ingredient in the recipe for success.

The original operation had only one male and three female employees. Products comprised low-torque potentiometers and a unique push-push switch invented by Arnold Simoni, the founder of the company. The switch could be mounted on the same shaft with a volume control so that, for example, a radio receiver could be switched on and off without disturbing the volume setting.

In 1951 Mr. Simoni moved his company to its present premises at 50 Wingold Avenue, Toronto 19, Ontario, and commenced manufacture of commercial volume controls.

The increase in procurement of defense electronic equipment which followed the outbreak of the Korean War created new demands for components that would meet the severe environmental and performance requirements of military specifications. In 1957, Precision Electronic Components Ltd. redesigned their units and retooled

to meet these requirements by producing a range of high performance variable composition resistors, completely designed and manufactured in Canada.

The most important aspect of the design of these potentiometers is the use of a heat-molded cylindrical resistance element instead of the conventional arc-shaped element. This gives a remarkably large working surface—the effective area is about eight times that of a conventional element in a potentiometer of the same basic dimensions. In addition, the heat-molding process leads to a long rotational life and extremely high stability.

Two-point growth plan

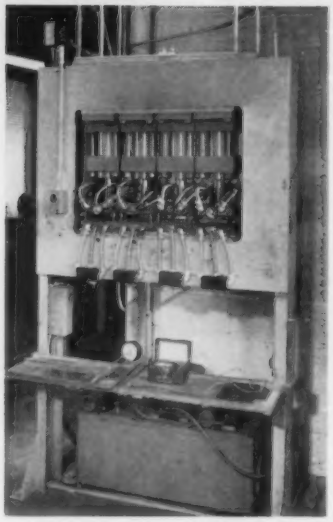
Mr. Simoni's plan for the growth of his company—now known as Precision Electronic Components (1956) Ltd.—has comprised two basic approaches. First, a continuing diversification of the product line to meet changing demands. Second, the plowing back into the business of a considerable portion of the profits.

The results of this plan are seen in the range of potentiometers now available, which runs from standard 1 3/32 in. dia units rated at three watts, 70 deg C (MIL-R-94, style RV-4), to a ⅜-in. dia unit available for both bushing and printed-circuit mounting and under development for a rating of ¼-watt, 70 C.

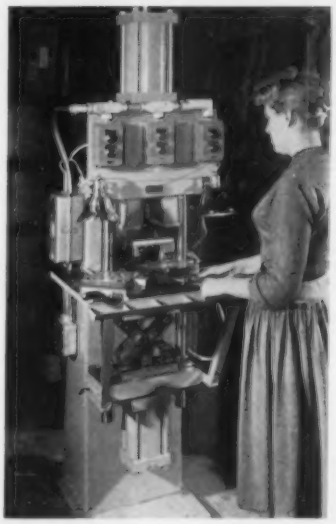
Capital has been invested in the equipment required for a comprehensive environmental test laboratory. This has enabled the company to carry out development projects as part of the program of DRB's Electronic Research and Development Committee. The ⅜-in. dia unit mentioned above is covered by one of these projects. Another was the development of a ¾-in. dia potentiometer for a rating of ½-watt, 70 C, with a rotational life of 25,000 cycles. Tests have shown that the unit could be rated at 1 watt, 85 C for 50,000 rotations.

In addition to the environmental laboratory, the production area is well equipped with instrumentation, most of it specially designed for this application. Another recent acquisition is a new molding press that will be used for production of the ½-in. dia style RV-6 unit. This control has been redesigned to include a plastic molding with five inserts. Employees now number 14.

Possibly the most significant achievement of the company has been its success in sales to U. S. customers, particularly for defense requirements. The demand proved to be so great that in 1958 a manufacturing facility was established by a New York company, producing controls to the Canadian designs. END



Specially designed press for molding resistance elements at very high temperature and pressure.



New transfer molding press custom made to PEC's design with two interchangeable molding plates.

Combination equipment that automatically cuts resistance element strips and sorts them into several categories.

Final inspection, in which the taper, noise and hop-off resistance values are checked in one automatic operation.

Tape controls all machine operations 90

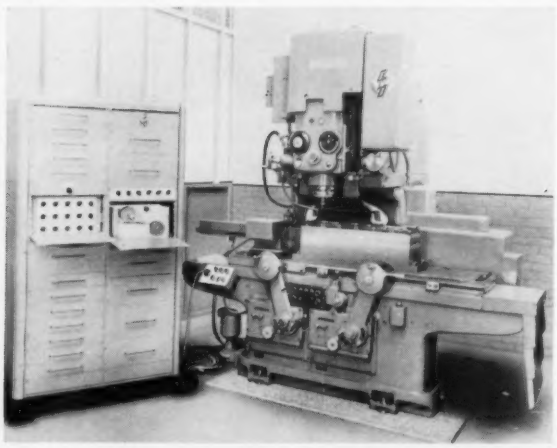
A versatile, automatic-tool-changing, tape-controlled combination machine that makes automation economically feasible for small-lot manufacturers has been developed by Kearney & Trecker Corporation with General Electric Company supplying the electronic program controls.

The new combination machine, which performs milling, drilling, reaming, tapping and boring operations, bridges the gap between job shop mechanization and automation.

The numerical control system makes the entire machine automatic. It not only directs positioning of the worktable and three-axis spindle; it also controls tool selection, tool changing, spindle speed, feed rate, and auxiliary functions such as turning coolant on and off when needed.

First step in processing a part for the machine consists of listing dimensions, machining sequences and auxiliary functions on a planning sheet. To do this, the engineer or technician takes the necessary information from a blueprint. Then a typist, using a standard typewriter-tape punch, transcribes the planning sheet data. To provide a visual check of the accuracy of the transcription, corresponding numbers are typed onto the planning sheet at the same time they are being punched into the one-inch, eight-channel input tape. After checking the typed numbers against those originally placed on the planning sheet, the tape is ready for use. If corrections are necessary, changed data can be quickly spliced into the tape.

At the machine, tape is read by a standard mechanical tape reader. The control system is equipped with dual storage registers to eliminate any loss of machine time while tape is being read.



Automatic drilling 91

E. M. I. Electronics Ltd. have developed a new machine tool control system designed to meet the needs of the small batch producer, giving improved production efficiency for a small capital outlay.

This system is to be supplied complete with a specially designed co-ordinate table operating on recirculating ball slides actuated by hydraulic cylinders.

The basic measuring element is the Inductosyn, which is a general purpose type with an electrical accuracy of ± .0005 in.

The position of the table is represented by an analogue voltage, as is also the position set up in the store unit. A comparison is made of these two analogue voltages and the difference amplified. The output of the amplifier is arranged so as to drive the table in such a manner as to make this difference zero.

The table drive is obtained by means of hydraulic cylinders pneumatically actuated and the locking of the table in the desired positions by means of hydraulic clamps.

Information is fed into the control system either in the form of 5 hole teleprinter tape, or alternatively, co-ordinates may be set up on dials for manual operation. For tape control, ordinates of x and y are read alternately from the tape using a tape reader, the output of which operates the store unit to set up the desired position analogue voltages, the machine controls, and the automatic cycling facility.

The operation of the system is as follows. The x ordinate is read and the table moves in x; the y ordinate is read and the table moves in y; the drilling operation is performed, and the head retracts after which the cycle is repeated. A green light indicates that the drilling position has been reached.

Electronic system for cylindrical grinders 92

An automatic measuring system for cylindrical grinders is now in operation at Lucas-Rotax Limited of Toronto. Called the Movolimit-Deltalimit System, the equipment comes from Fritz Studer Limited of Switzerland. It is the first of this make and one of only a few such units operating in Canada.

The electronically controlled system has a consistent accuracy of ± .00004 in. It is comprised of three separate units:

1. The measuring head, which contains a precision resistor element and makes continuous two-point diameter readings directly at the point of grinding, is either mounted to the slide of the machine or suspended from the wheelhead. The reading points are carbide tipped.

2. The indicator instrument is composed of a millivoltmeter, three signal lights and control relays. It has coarse and fine scales with total scale readings of ± .002 in. and ± .0002 in. respectively. The green signal light indicates work diameter is oversize; the yellow, between roughing and finishing size; and red, that the finished size within tolerance has been reached. There are two manually adjustable fixed pointers for indicating allowable tolerance range and a moving pointer indicating simultaneously, relatively of workpiece to tolerance, concentricity, circularity and parallelity.

3. The measuring and control amplifier unit provides two decade resistor controls for independently setting the control relays; a manual change-over switch for coarse-fine selection; a remote zero adjustment for the live indicator pointer; and a power switch with signal light.

The indicator is placed at eye level on the machine while the amplifier can be placed on any convenient table several feet from the machine.

There are two different methods of operation. If the grinder is of the mechanical type, the Movolimit may only be used as a single piece measuring system. The indicator is set according to the amount of material to be removed and the desired tolerance. As the grinding progresses, the actual decrease in diameter is shown on the instrument. By this manual method, single work-pieces are produced and the control of the machine remains the responsibility of the operator.

In the case of repetitious work on hydraulic machines the sequence of operation is as follows: The system is calibrated electrically to a master component or the first work-piece produced by the previously mentioned manual method. The Movolimit then controls the working cycle of the machine commencing simultaneously with: The approach and engagement of the measuring head; Rapid approach of the wheelhead; Starting of the spindle and table movement.

The system then controls: The roughing operation, regardless of the number of strokes; Stopping of the wheel in-feed by the "roughing control" relay; Sparking out and sizing by the "finished size" relay.

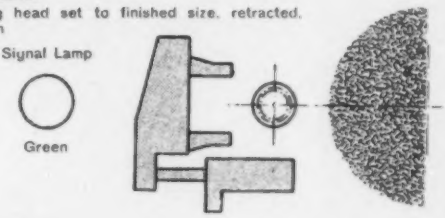
The elements of the machine and system are then returned automatically to their starting positions. Once set, the sequence of operations may be repeated as often as required and components are produced consistently within the tolerances previously mentioned.

The Cosa Corp. of Canada Ltd., distributes this equipment.

Sequence of Automatic Operations

on the hydraulic cylindrical grinding machines STUDER types RHU 450 and RH 750 with automatic size control by MOVOLIMIT

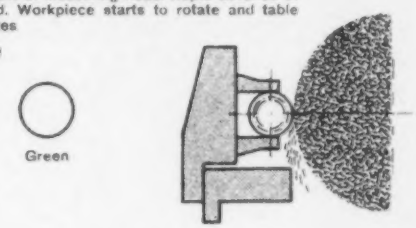
Starting position:
Measuring head set to finished size, retracted, arms open



Single lever control

Start of automatic machine cycle:
Engagement of measuring head. Rapid advance of wheelhead. Workpiece starts to rotate and table reciprocates

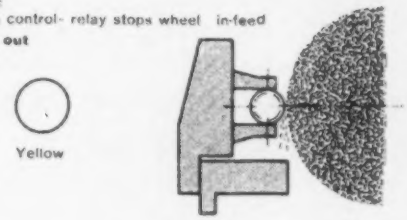
Roughing



Automatic

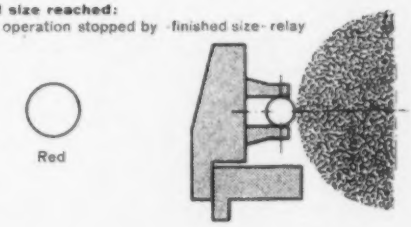
Finishing:
Roughing control- relay stops wheel in-feed

Sparking out



Automatic

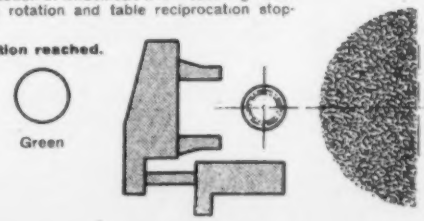
Finished size reached:
Grinding operation stopped by finished size- relay

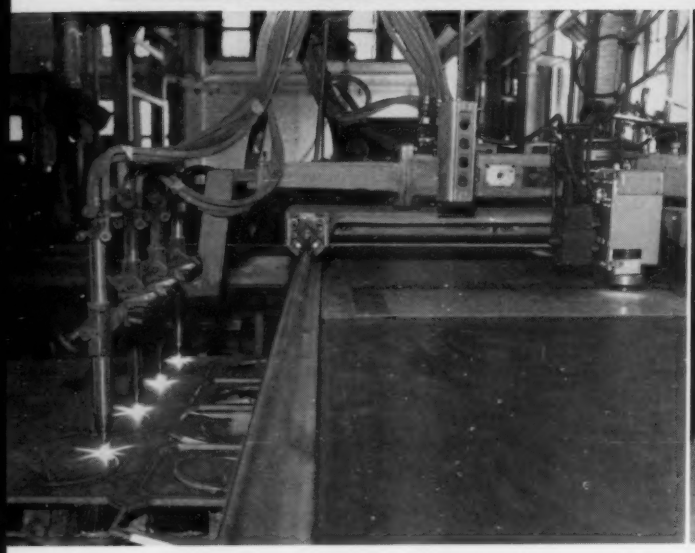


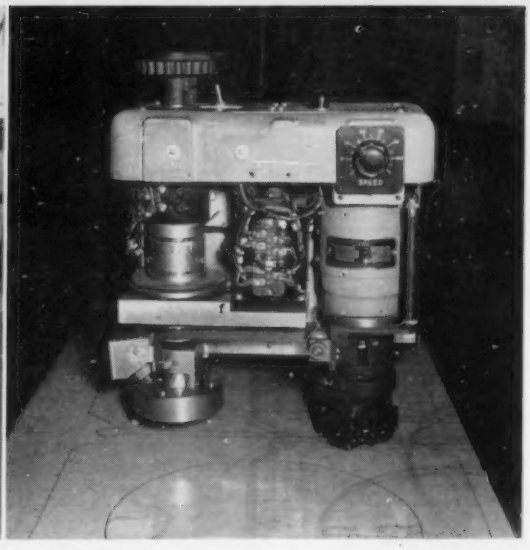
Automatic

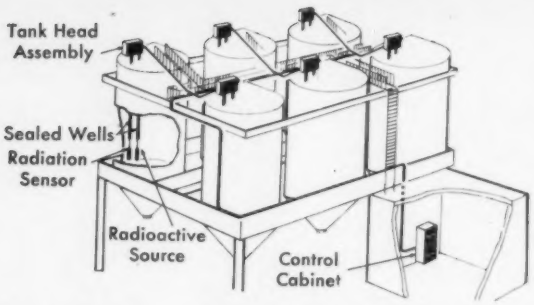
Reset:
Rapid retraction of wheelhead and measuring head. Workpiece rotation and table reciprocation stopped.

Starting position reached.









Tank level gauge uses gamma radiation 93

Electronic Associates Ltd., Willowdale, Ontario, have developed a number of electronic systems for the measurement of level of solids, liquids and slurries in all types of vessels and under various conditions of temperature, pressure, pH, density and viscosity. Single-point, multiple-point and continuous type level measuring systems are now available which do not require special materials of construction, seals or purges.

The EA-TLG-100 tank level gauge is a continuous, full-range measuring system designed for tanks up to 60 feet high. It will work equally well on solids, liquids, or slurries, regardless of density or viscosity. A single control unit with manual or automatic switching can be used to monitor the level in a number of tanks. High and/or low alarms may be added to give a visual or audible alarm should any or all of the tanks fill or empty beyond a preset safe limit. Manual control is provided so that any buildup or bridging condition may be noted. Read-out may be on an indicating meter, recorder or automatic printer.

In operation, the radiation source and the sensor move up or down twin 2-inch pipe wells within each tank. Since the pipes can be placed quite close together, a low level radiation source can be used. In addition, the pipe wells are completely enclosed within the tanks so there is no radiation hazard.

Photocell controls oxy-acetylene cutter 94

The Linde Photocell Tracer, a photoelectric tracing device designed for attachment to oxy-acetylene shape-cutting machines, has been introduced by Linde Company, Division of Union Carbide Canada Limited. Sold under the trademark "L-P-T," this new unit incorporates Linatrol, a recently developed Canadian Westinghouse Company electronic circuit. It automatically traces from a simple pencil or ink line drawing, a great advantage over most existing photoelectric tracing devices which will only follow the edge of a wide line or silhouette.

Superseding the older type strip and magnetic drive heads used on shape cutting machines, the "L-P-T" Photocell Tracer eliminates the necessity of making costly strip or magnetic templates. In many shops, the saving on templates alone could amortize the cost of this new tracer in less than a year.

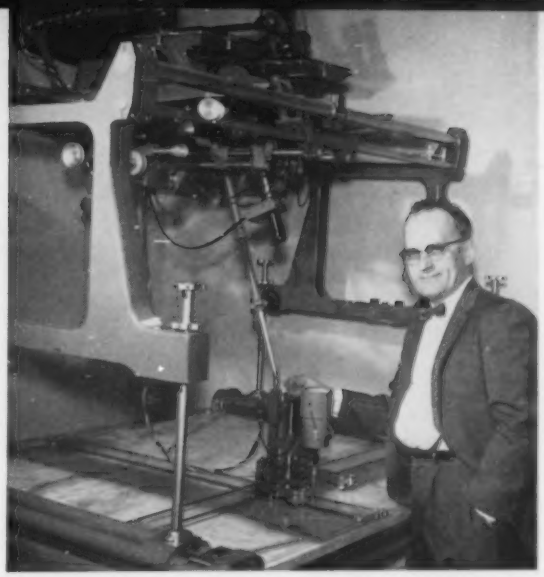
The basic component of the unit is a photoelectric scanning head which controls a servo steering motor. This steering motor is in turn connected to a driving head, which rides on a sheet of ⅛-in. Lucite which directly overlays the drawing.

This whole assembly mounts on the cutting machine by means of special brackets and lift mechanisms. The main control box, which is connected to the tracing head by means of a 25-ft. multi-conductor cable, is remotely mounted on a wall or other similar support.

During operation of the unit, a photocell on the end of a vibrating reed scans across the template line. Output from this photocell is fed to the steering motor which, in turn, controls the driving head and also maintains the photocell centred over the template line.

This system is very accurate and dependable when used on suitable line drawings. Tracing accuracy of within plus or minus .005 deg. is obtainable. Turns of up to 90 deg. with a 1/16-in. radius can be made at a speed of 16 in. per minute. Moreover, the unit is not sensitive to ambient light sources and consequently cutting operations can be carried out in brilliantly lighted areas.

Electronic scanner runs stereo plotter 95



Final realization of the modern mapmakers' dream—the automatic drawing of contour lines showing ground elevations—has been achieved in an instrument developed by a Canadian group of air survey companies.

The Stereomat or Automatic Scanning Correlator (previously known as AUSCOR) was developed by Mr. G. Hobrough (see photograph) of the Research and Development Division of Hunting Associates Limited, Toronto.

The process of making accurate maps from aerial photographs involves determination of elevations of ground points, so that contour lines showing the terrain relief can be drawn. In other applications, it may be desired to know the terrain profile along a designated path.

The determination of relief is obtained by viewing the common area between two overlapping aerial photographs. The amount of parallax (relative displacement of conjugate images) along the base line between the two pictures (X parallax) is a measure of the elevation. It is also necessary to remove components of parallax in a direction perpendicular to the base line (Y parallax).

The function of perceiving parallax and the subsequent removal of Y parallax through relative orientation has been of necessity a human function. The operator of a stereoplotting instrument must be highly trained, and have faultless depth perception, in addition it is a slow and tedious business.

The stereomat is a system of electronics and electromechanics, which may be attached to a conventional stereoplotter to perform the following functions automatically.

a) Determination of the X and Y parallax at any point in the stereo model.

b) Remove Y parallax during relative orientation automatically.

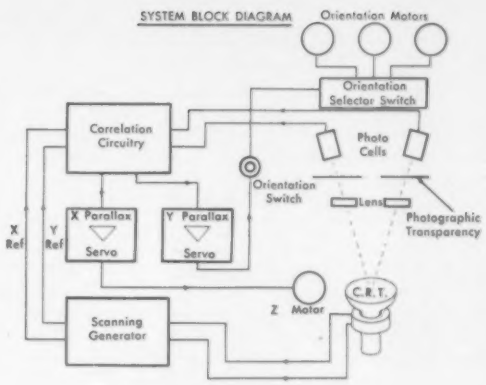
c) In the profiling mode, it corrects X parallax at all times by actuating the vertical movement of the projection platform, thus keeping an index mark on the terrain surface. This provides a continuous profile of the relief along any selected path in the stereo model, as the index mark is moved along the path in a horizontal plane.

d) In the contouring mode, the vertical interval or elevation is held constant, and X parallax information is used to derive information for steering the index mark through the stereo model, thus producing contour lines.

The stereomat system solves the following problems:

a) It identifies corresponding points in the two photographs of the same object taken from different positions. This is accomplished by scanning the area around each point by a spot of light from the crt moving in a random pattern around and across the area being examined. The varying light impulses resulting from boundary crossings in the photograph are converted to electrical signals by photo multiplier tubes. Associated electronic circuitary measures correlation of the electrical signals resulting from each photograph. The correlation is a measure of the common scanning area that is being searched. If the correlation is weak, the scanning pattern expands and vice versa. Thus points of image detail are identified by the context in which they appear.

b) After identifying the images, it determines the direction and magnitude of the parallax in both the X and Y directions separately. The circuitry thus produces two dc voltage, one for Y parallax and one for X parallax. The polarity of the voltages is dependent upon the direction of the parallax, and the magnitude upon the amount of parallax.



c) The X parallax error voltage is fed to a servo motor which actuates the elevation of the projection table (index mark). When the error voltage becomes zero, the servo motor stops and the index mark is on the terrain surface.

d) The Y parallax error voltage is automatically switched to appropriate servo motors which actuates the projection heads of the plotting instruments to remove Y parallax.

e) In the contouring mode, X parallax error voltage is combined with other information generated by the circuitry, to actuate X and Y servos which move the index mark in the horizontal plane in the direction necessary to maintain the mark on a selected contour line.

In the photograph, the flying spot crt is shown directly in front of Mr. Hobrough's hand. The photomultiplier tubes are at the extreme top with the stereo photos just beneath them on the small flat holders. Light passes from the crt, up through the stereo pair to the photomultiplier tubes. Servo motors drive the crt assembly up or down to locate the position for coincidence.

The associated power supplies and control circuits are contained in a separate console mounted beside the plotting table. END

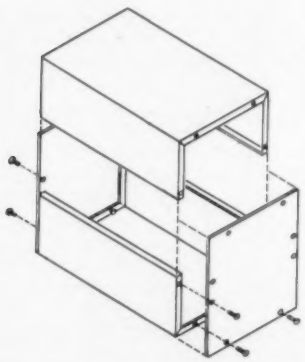
Design ideas

This new feature in CEE will present solutions to tricky circuit design problems, new ways of using test equipment, etc. If you have a good idea, jot it down, draw a sketch if necessary, and send them to the editor. You will receive $5.00 and a credit line for each idea accepted for publication.

Inexpensive enclosure

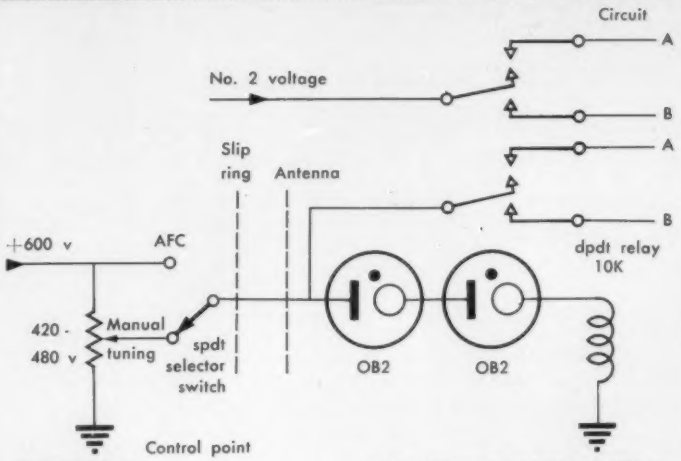
When I needed an enclosure for a small 6-volt power supply I made a very satisfactory one from two of the Hammond 1419 open-end aluminum chassis. (I used 1419-D giving me an enclosure 4" x 5" x 7"). The chassis are held together by simple flat end-plates of 1/16" aluminum fastened with self-tapping screws. The drawing shows the details.

The components can be mounted to the inside of one chassis, the other acting as a cover, or they can be mounted to both chassis with the leads left long enough to allow the chassis to be separated. Alternatively, a sheet of aluminum can be mounted inside one chassis to carry the components.



If all of the controls, connectors, etc. can be mounted on one end plate, and if flat-head screws are used on all of the other faces of the enclosures, the completed unit will occupy little space. A number of them can be stacked neatly. Remember to provide ventilation holes if heat-producing components are mounted inside.

Dr. P. H. Byrne,
VE3AXX
Toronto.



Switching elements

A simple application of vr tubes as switching elements in series with the coil of a standard relay can be made. Recently in this Division of NRC we were required to switch from manual tuning to afc with only one slip ring and ground available to carry the voltage from the control point to the rotating antenna. This circuit was used.

With the selector switch in the manual position the maximum voltage (480 v) is not sufficient to strike the OB2's. Thus the relay remains unactuated. However, when the selector switch is in the afc position, the 600 v strike the OB2's and the relay becomes actuated. Thus any number of other voltages can be switched simultaneously with the choice of afc or manual tuning.

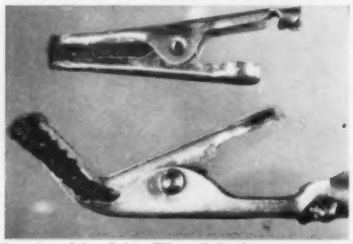
Some care must be taken to choose a relay coil with sufficient resistance to limit the current through the vr tubes to their workable ratings.

Similar applications of vr tubes can be made for overvoltage protection circuits. Where care is exercised in choosing a relay coil of suitable resistance, neon tubes or zener diodes can be used in place of vr tubes.

R. S. McClean,
National Research Council.
Ottawa.

Heat sink

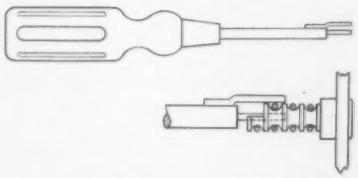
In soldering electronic components to circuit cards, heat is conducted along the lead wire from the soldered joint to the component. Unless some precautionary measure is taken, sensitive components can be damaged by the heat. To prevent such damage, a Boeing manufacturing research engineer developed a novel "heat sink" consisting of a standard metal clamp



lined with felt. The felt is saturated with water and the clamp attached to the lead wire between the soldered joint and the component. Heat traveling along the lead wire is dissipated by evaporation of water from the felt, thus protecting the component.

Boeing Airplane Co.,
Seattle, Washington.

Wrapping tool



Wrapping component leads and hook-up wire around a turret terminal is greatly simplified with this wrapping tool. It was made from a screw driver with the blade ground to a cylinder, and an extra piece welded onto the shaft as shown.

R. Luker,
Canadian Westinghouse
Hamilton.

For your library

Basic theory on control systems using data sampling techniques

Sampled-Data Control Systems

Eliahu I. Jury; John Wiley & Sons, Inc., New York; 453 pp; $16.

Reviewed by H. Ratz, Fischer & Porter (Canada) Ltd., Toronto.

This book presents the basic mathematical theory applicable to sampled-data systems. Prerequisites for the reader are an understanding of feedback system theory and operational circuit analysis or a previous acquaintance with the analysis of sampled-data systems in the complex plane.

Control systems involving sampling techniques occur whenever measuring devices, computers, or data transmission links are time shared among several control functions. The incorporation of an electronic digital computer in a real time control system necessarily changes it to function as a sampled-data system. The problem of radar tracking is an example in which the input information is available only in samples.

An extensive discussion is given of a mathematical technique for the analysis of sampled-data systems based on an extension of the Laplace transformation known as the z-transform method. Using this method, sampled-data feedback systems are analyzed using both the root-locus and frequency response approaches. Procedures are described for synthesizing compensators in feedback sampled-data control systems to give either continuous compensation or discrete compensation. Physical realization of discrete compensators such as digital computers, networks with delay elements or pulsed procedures are illustrated. Finally, the techniques are expanded to the approximate analysis of continuous systems, to the solution of difference equations and to sampled-data problems with a finite sampling pulse width.

This book will provide a useful reference for instructors, research workers and engineers already practicing in the field. Others will find it a difficult introduction to the subject. There are extensive tables of transforms, a bibliography and practice problems.

Topics in Electromagnetic Theory

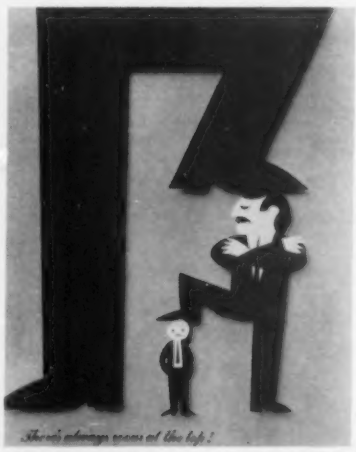
Dean A. Watkins; John Wiley & Sons, Inc., New York; 118 pp; $6.50.

Reviewed by Dr. M. P. Bachynski, Associate Laboratory Director, RCA Victor Co. Ltd., Research Laboratories, Montreal.

This volume presents the fundamentals related to modern advances in microwave electron tubes and ferrite media. In four brief chapters are covered periodic transmission systems, propagation on a wire helix, coupling of modes and anisotropic media.

Firstly the behavior of periodic systems which are of importance in traveling wave amplifiers, backward wave oscillators, and microwave and video filters is developed from basic theorems. Both the field approach and the equivalent circuit approach is used to determine velocity vs. frequency characteristics and impedance. Next the most important of the periodic structures, the helix, is considered at length, both as a slow-wave structure used for microwave tubes and as a helical antenna and a helical delay line. In the third chapter, the coupling mode theory due to J. R. Pierce of the Bell Telephone Laboratories is developed for both discrete and continuous coupling and applied to devices such as directional couplers, periodic transmission systems and microwave electron tubes (klystrons, resistive wall amplifiers, velocity jump amplifiers, traveling wave tubes, etc.). The final chapter deals with the permeability of an anisotropic medium and propagation in a saturated ferrite medium. A brief outline of the operation of practical ferrite devices concludes the book.

This publication is a coherent and readable presentation of some of the underlying principles of microwave electronics. It serves adequately its initial purpose, that of a text for a graduate course in electrical engineering. However, due to the restricted nature of the subject matter, only the specialist will find it a useful reference text.



That one small, cheery voice occasionally heard crying in the wilderness of contemporary cynicism has piped again. "There's Always Room at the Top" (copyright Beckman Instruments, Inc.) cheerily dusts off an outmoded Algerism. The art gallery masterpiece is available free on request.

R-O-R Associates, Don Mills Rd., Don Mills, Ont. (129)

Catalogues and brochures

A general specification for the preparation of commercial instruction manuals on electronic equipment; 60 pages. Electronic Associates Ltd., Willowdale, Ont. (101)

Kelvin Scale. News sheet with current information on cyrogenics and related subjects will be published periodically. Arthur D. Little Inc., Cambridge, Mass. (102)

The Engineer and Scientist in Management. A bi-monthly newsletter to keep technical administrators informed on pertinent subjects of a managerial, personal and social nature. Vision Inc., New York. (103)

Nomenclature for rotating servo components. This 12-page booklet covers standard mil type synchros, resolvers, servo motors and tachometer generators, published by Ketay Dept., United Aircraft Corp., New York. Canadian Pratt & Whitney Aircraft Co. Ltd., Montreal. (104)

The A B C of high frequency induction heating of metals. Booklet explains induction heating and its application to hardening, annealing, soldering and melting, with examples and diagrams; 20 pages. Philips Electronics Industries Ltd., Toronto. (105)

Fabrication gaps in Canadian manufacturing industry. Booklet contains statistics on imports over $1 million per year and points out possibilities for new industries; 14 pages. Ontario Department of Planning and Development, Toronto. (106)

Data sheet 142 proposes technique for evaluating effectiveness of shielding magnetic tape in Netic and Co-Netic tape preservers vs. unshielded tapes. Magnetic Shield Division, Perfection Mica Co., Chicago. (107)

Technical bulletin, informs scientists and engineers of the latest electronics developments from A/S Danbridge, Copenhagen. J. W. Ellis Industries, Toronto. (108

Antenna systems catalogue contains 96 pages of engineering data on Andrew products including general antenna systems information. Andrew Antenna Corp. Ltd., Whitby, Ont. (109)

Reference guide for 1959 to silicone uses and applications. Dow Corning Silicones Ltd., Downsview, Toronto. (110)

A two-color booklet on recording instrument charts, graph sheets and other printed products has been issued by Canadian Charts and Supplies Ltd., Oakville, Ont. (111)

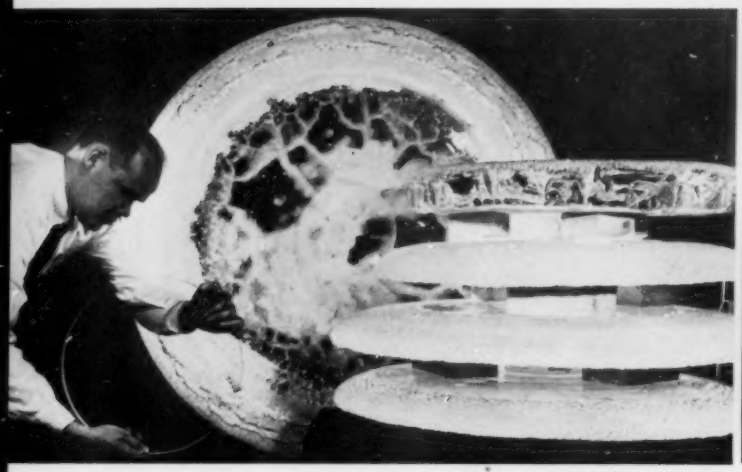
Silicone rectifier handbook. Catalogue No. 69 is a revised and enlarged 49-page handbook with electrical ratings, performance data and dimensional drawings for Sarkes Tarzian silicon rectifiers. A. T. R. Armstrong Ltd., Toronto. (112)

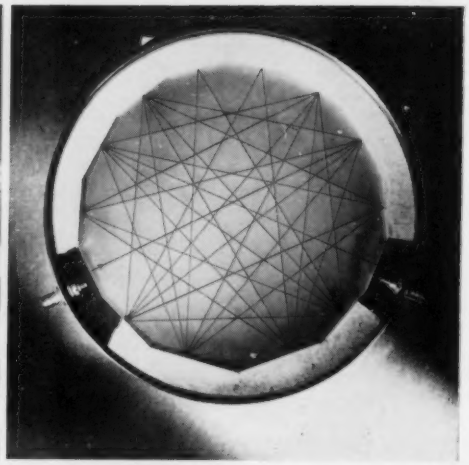
Two-way mobile radio communication systems. A 20-page booklet, ECR-479, describes uses of two-way radio communications. Canadian General Electric Co. Ltd., Toronto. (113)

(Continued on page 49)

What's new in view

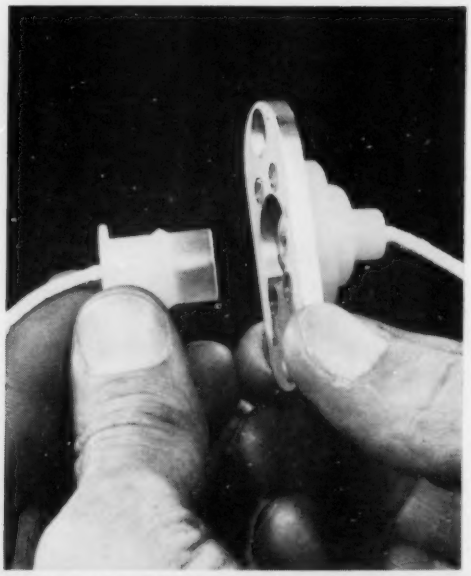
Geometry shapes the new developments





Extra-large boules of pure silica now enable Corning Glass works to make ultrasonic delay lines with delay times up to 15,000 usec. Production of the ultra-pure glass will be moved this summer to the Electronic Components Department, Bradford, Pa., upon completion of a new plant there.

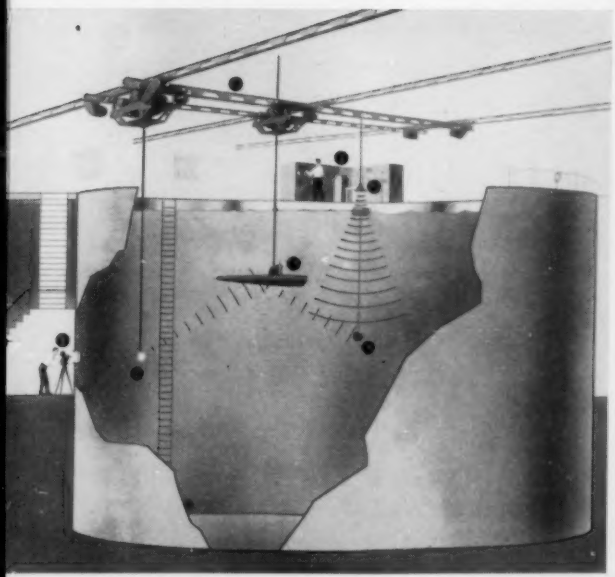
This infrared dome, manufactured by Servo Corporation of America, is claimed to be the largest dome manufactured in one piece. It was made for the United States Navy.



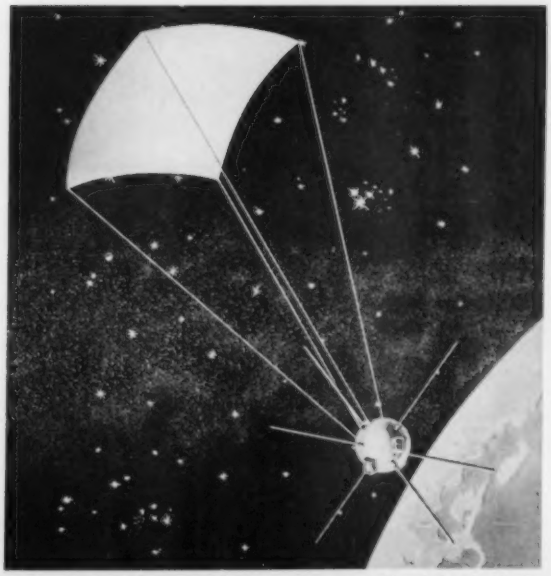
Plaskon nylon 8,200 was used to mold this missile motor fire connector. It carries electrical firing charge from launcher to missile ignition system.

This is the tracking antenna which received signals from the first successful U. S. space probe missile. Shown here under construction, the antenna is 110 feet high and 85 feet in diameter. Photo was supplied by Blaw-Knox Co.

Antenna, here displayed in a clear plastic radome, simultaneously detects three dimensions: distance, bearing and altitude. It is part of the U. S. Army Signal Corps' Frescanar developed by Hughes Aircraft Company.



In Stromberg-Carlson's 400,000 gallon sonar test tank, spark (2) provides broad-band sound for echo ranging tests with model submarine (1) and hydrophone (3).



Scientists at General Electric claim an aluminized plastic sail 200 ft. sq. could increase speed of a 25 lb. satellite by 300 mph each day. Sun's photons provide pressure.

Scientists discover last predicted particle of ordinary matter

A group of scientists at the University of California's Lawrence Radiation Laboratory have discovered the Xi-zero neutral cascade hyperon atomic particle. This completes the list of the presently-predicted set of particles of ordinary matter. A few predicted anti-particles have not been detected yet.

The Xi-zero particle, with a mass of about 40% greater than that of a proton, has a zero electrical charge and exists for only a few billionths of a second. When it decays, it disintegrates into two zero-charged products. Since these primary decay products are electrically uncharged they cannot be directly observed in the laboratory. Their existence and the existence of their "parent," the Xi-zero particle, can only be inferred from the presence of its "grandchildren."

The particle was discovered by means of the Laboratory 15″ liquid hydrogen bubble chamber. The chamber was exposed to a beam of particles from the bevatron. The scientists found only one photograph (out of a series of 70,000 taken during experiments) with evidence of the creation of the Xi-zero.

Experimental evidence of this particle provides a basis for greater confidence in present theoretical interpretations of the nature of matter.

U. K. buys nuclear submarine plant

The United States has authorized the transfer to the United Kingdom of a complete Skipjack-type submarine nuclear propulsion plant, spare parts, design and related data.

The Westinghouse Electric Corp. has contracted to sell to Rolls Royce, an agent of the British Admiralty, for installation in the United Kingdom's submarine, Dreadnought, a complete reactor similar to those being installed in the latest U. S. Navy submarines of the Skipjack class. The hull of the Dreadnought has been modified to accommodate the reactor. Spare parts, the reactor core and technical and manufacturing assistance, and classified information including restricted data related to the plant also will be supplied.

A main objective of the transfer is to provide the U. K. with technical and manufacturing assistance and knowledge to enable that Government to speed the building of similar submarine nuclear propulsion units for use in the Royal Navy.

Can we make better use of isotopes?

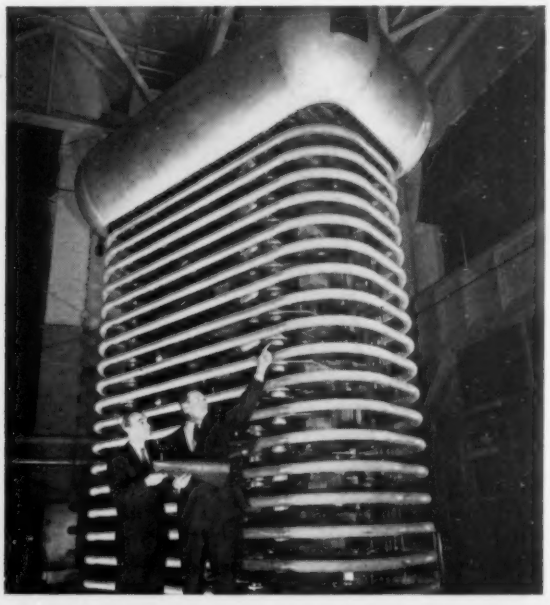
Samuel S. Auchincloss, president of Tracerlab Inc., in a statement to the Joint Congressional Committee on Atomic Energy, warned that the reluctance of industry to accept the uses of radioisotopes in industry is costing the United States hundreds of millions of dollars in savings.

"Under our present program for isotope utilization, the AEC has sponsored many technical studies leading to reports on the subject or to the training of technical people through contracts frequently with non-profit institutions and universities. The information available from their reports has been distributed generally to other technical people. Our own experience, however, indicates that this information is not getting into the hands of the management people who are responsible for decisions regarding capital expenditures in a form which leads them to take positive action. In substance, we are not getting through to enough of the people who should use isotopes and whose wider use of them could produce greater savings than we now enjoy."

For additional views on this subject see "Train cars use radioactive codes to record their movements," page 32.

In mid-February, John A. McCone, chairman of the U. S. Atomic Energy Commission announced that the amount of radioisotopes shipped from the Oak Ridge National Laboratory for use in peaceful applications increased 37% during 1958.

A total of 228,717 curies of radioisotopes were shipped during 1958, compared to 166,652 curies during 1957. A total of 614,565 curies have been shipped from the laboratory since the radioisotopes program was started on August 2, 1946.



During the past five years General Electric Co. has invested some $1,500,000 to equip their General Engineering Laboratory with facilities for studying nuclear radiation. At left is one of the two 1-MeV accelerators. Above, E. A. Hilbert uses cctv to study experiments in the cobalt chamber. In this 22 ft. x 12 ft. x 10 ft. room entire machines can be tested at a maximum of 500,000 roentgens per hour. The source is 10,000 curies of cobalt 60.

Reports—continued

New representative for Assembly Products

Aeromotive Engineering Products, Ltd., Pointe Claire, Montreal, Que., has been appointed exclusive sales representative in Canada for Assembly Products, Inc., manufacturer of sensitive instruments and controls, Chesterland, Ohio.

Aeromotive will stock the most popular models of API meter-relays and panel meters, and will also handle repairs for Canadian customers.

Exclusive representative for two U. S. companies

W. S. Kendall, marketing director of Computing Devices of Canada Ltd., announces the signing of exclusive agency representation agreements with the American Research Corporation and the All American Tool and Manufacturing Company.

American Research Corporation manufactures environmental test facilities ranging from sand and dust chambers to vibration test chambers. All American Tool and Manufacturing makes a range of vibration fatigue testing machines as well as precision filing machines.

Alberta company makes vhf equipment

Electronic Research & Development Co. Ltd., Calgary, Alta., has been licensed to manufacture land-mobile radio communications equipment by Allen B. Du Mont Laboratories Inc., of Clifton, New Jersey, acting through its Canadian licensing subsidiary, Du Mont Television and Electronics Ltd., Montreal.

New source for Canadian wire-wound resistors

Arrow Radio Company, Toronto, have recently commenced manufacture of wire-wound resistors for all power ratings, insulated or non-insulated, cement or vitreous enamel finish.

Information on these and other Arrow products may be obtained from their new Canadian sales representatives, Douglas Randall (Canada) Ltd., Scarborough, Ont.

Electronic Controls Ltd., Belleville, Ont., have appointed Douglas Randall (Canada) Ltd., Scarborough, Ont., as their sales agents for Ontario and Western Canada (industrial rectifiers, dc power supplies, dc braking equipment, magnetic amplifiers, and specialized industrial electronic equipment).

People in the industry — continued

Canadian Marconi promotions

Stuart M. Finlayson, president and general manager of Canadian Marconi Co. has announced that **W. H. Hopkins,** assistant general manager and secretary, is to retire after a lengthy career, but will continue with the company in a consulting capacity.

A. G. McCaughy is appointed secretary-treasurer, responsible for all financial, accounting, legal and administrative functions.

W. V. George becomes assistant general manager, directly responsible for the operating divisions of the company.

Scientist accepts university post

One of Canada's leading scientists in the field of transistors, **N. F. Moody,** will join the faculty of the University of Saskatchewan. His appointment as professor of electrical engineering was announced by Dr. Arthur Porter, dean of the college of engineering.

At the present time Mr. Moody is in charge of the basic circuit research section of the Defence Research Board. He has served with the electronics branch in the atomic energy project at Chalk River, and with the electronics division of the United Kingdom atomic energy weapons group.

Sales manager

John W. MacLea, P.Eng., has been appointed sales manager of Canadian Line Materials Ltd., Toronto. He has been sales promotion manager since 1955 and prior to that was field engineer in northern and south-western Ontario.

Four appointments at Lenkurt Electric

C. W. Hunter, vice-president and general manager of Lenkurt Electric Co. of Canada Ltd., has announced the appointment of **H. R. Herron** as marketing manager for the company, **T. D. Cushing** as engineering manager, **Richard A. Robinson** as manager, sales engineering, and **Edward V. Hird, P.Eng.,** as manager, contract projects.

Mr. Herron, a graduate of U. B. C., and a member of AIEE, served in the RCAF during World War II. He was employed in the engineering department of C. N. Telegraphs prior to joining Lenkurt.

Mr. Cushing, whose new position as engineering manager was recently created, studied at U. B. C. and is a member of IRE. His experience includes eight years with Northwest Telephone Co., Vancouver, where he was responsible for major radio engineering projects, including the B. C. portion of the Trans-Canada TD-2 system. He was formerly with Electronic Laboratories of Canada, and National Research Council.

CAMPBELL

Herron

Cushing

Hird

Robinson

Mr. Robinson, who is a member of the Association of Professional Engineers of Alberta, and also a member of the IRE, attended University of Alberta, Imperial College of Science, London, England, and Colorado School of Mines. A veteran of the RCAF and RAF, he was formerly with California Standard, Northwest Telephone Company, and Bell Telephone. Since joining Lenkurt, he has held the positions of manager, radio engineering sales, and manager, contract projects.

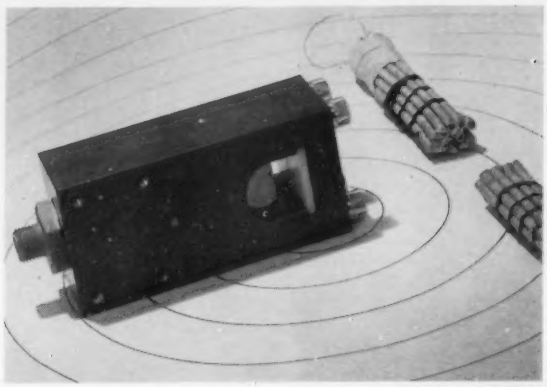
Mr. Hird, a U. B. C. graduate and RCAF veteran, is a member of the Association of Professional Engineers of B. C. He was a reserve officer in the Telecommunications Branch, RCAF, from 1953 to 1955. Formerly an equipment engineering with B. C. Telephone Co. he joined Lenkurt as applications engineer in April, 1956.

President and chairman of industrial foundation

W. H. Evans, president of Honeywell Controls Ltd., has been elected president and chairman of the board of directors of the Industrial Foundation on Education. For the last two years he has been chairman of the foundation's management committee. Succeeding Mr. Evans in his former capacity is **A. R. Williams,** assistant to the president of A. V. Roe Canada.

New products

130



134

Du Mont produces tubes 130

With development and production facilities completed, Allen B. Du Mont Laboratories, Inc., are now producing planar triodes and related microwave tubes. An immediate production run has started for the company's first microwave tubes. An immediate production run has operates in the 4,000- to 5,000-mc range. It is a direct replacement for the type 416B, except that it has much tighter tolerances.

The new tube is gold plated for high Q operation and has a gain of 9 db minimum at 50 mw output. Transconductance rating is 50,000 micromhos.

Bayly Engineering Ltd., Ajax, Ont.

Inventory control system 131

A great many data handling systems have been developed in recent years to speed the processing of complex business information. The effectiveness of any such system depends, in the final analysis, upon the speed and accuracy with which its input data can be supplied.

The Codatron II permits the automatic selection of precoded data for application to punched cards, punched tape or magnetic tape, and eliminates the principal problems encountered in the coding of input information for data processing purposes.

The system comprises a control unit, which provides visual code indication, and one or more code selector units, each of which permits selection of 300 individually identified items. The equipment is designed to facilitate future additions as required, and there is no machine limitation on the number of selector units which may be used with one control unit. A typical seven-section installation allows one operator to process 4,000 items per day. Either single or multiple code selection is possible and a keyboard is provided for the integration of variables. The machine is fully interlocked to prevent omissions or errors in coding.

Electronic Associates Ltd., Willowdale, Ont.

Transit case 132

Type TC-4 transit cases are made to order to fit the customer's equipment. They can be designed for equipment weighing up to 150 lb and measuring up to 2 ft in principal dimensions. The body is made for 3/32 in. thick aluminum alloy, using a simple welded construction. Internal pads are made from polyurethane foam, covered with canvas duck to minimize friction and tearing. The lid is secured by means of four snap-action draw catches which pull the lid snugly against a sponge rubber gasket to form a dust-tight seal. Two of the fasteners have locking snaps.

Pylon Electronic Developing Co. Ltd., Montreal.

Metal-ceramic resistors 133

A major break through in resistance element design is claimed for these new resistance elements. The elements are produced by a process which fires a metal resistance path on to ceramic at temperatures exceeding 600 C. This produces an element which is stable up to 500 C.

Present data indicates a temperature coefficient under 250 ppm/deg C over a range of —63 C to +150 C. Resistance range is from 10 ohms to 100 K per square. Ceramic bases can be made in a wide variety of shapes and sizes. The metal resistance film can be made to cover an entire surface or an accurately defined pattern.

C. C. Meredith & Co. Ltd., Streetsville, Ont.

Non-shorting cable cutter 134

Having a highly specialized missile application, this propellent-actuated guillotine cutter is capable of severing a cable bundle without short-circuiting the individual conductors. This is accomplished by the use of a ceramic cutter blade being driven through the cable bundle on to a ceramic anvil. Driving power comes from a standard screw-in explosive cell.

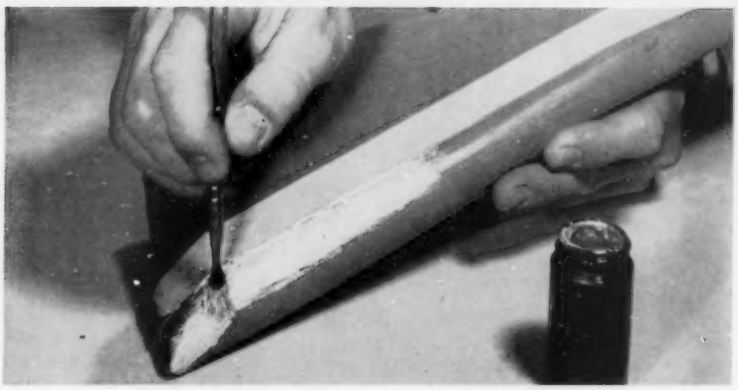
Beckman & Whitley, Inc., San Carlos, Calif.

Miniature differential 135

These miniature differentials have been introduced by Helipot for use as speed controllers, or as sensing devices for mechanical comparison or error measurement. In stock for immediate delivery are BP-301 with ¼-in. shaft, 0.065 oz-in. breakaway torque, maximum recommended torque 150 oz-in. and maximum recommended speed 1,800 rpm; BP-310 with 3/16-in. shaft, 0.060 oz-in. breakaway torque, maximum recommended torque 100 oz-in. and maximum recommended speed 1,800 rpm; BP-320 with ⅛-in. shaft, 0.060 oz-in. breakaway torque, 90 oz-in. maximum recommended torque and maximum recommended speed 1,400 rpm.

R-O-R Associates, Ltd., Don Mills, Ont.

For more information on New Product and Catalogue items, use the Reader Service Cards on pages 61 and 62



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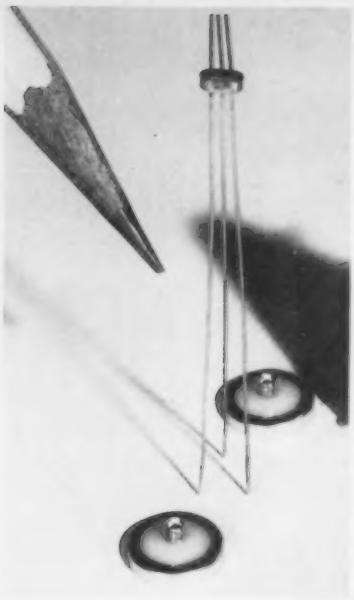

138

Epoxy conductive coating 136

Hysol 6251 is a new conductive coating based on epoxy resins. It is recommended for rebuilding areas worn away by sliding contacts, and as a conductive base for plating plastics when reliable bonds of the coating to the plastic are necessary. Full cure can be effected in forty-eight hours at room temperature or in as little as seven minutes at 300 F. The volume resistivity of the coating at 25 C is 0.0008 ohm-cm.

Hysol (Canada) Ltd., Toronto.

Communications masts 137

For am, fm, hf, vhf, and uhf installations, the heavy duty 20 series masts permit greater heights than can be attained with the class 10 masts. They go to 300 ft. as a vertical radiator.

CSA approved, the 20" face triangular steel structure is designed to withstand winds up to 100 mph. The staggered bracing and overlapping splice connection give maximum structural strength. All girts and braces are resistance welded to the Canadian Welding Bureau Code to ensure accurate sections. Complete hot-dip galvanizing after fabrication provides life-time protection from the elements.

To simplify erection, the masts are built in 10-ft. sections, weighing 10.8 lbs per ft. The masts can be used with a hinged base as an antenna supporting structure or with an insulated base for am transmission. Accessories available include such items as a six-way torsion resistor, lighting kits, antenna mounting plates, anchors, strain insulators and turnbuckles.

Beatty Bros. Ltd., Fergus, Ont.

Pressed and sintered glass 138

A pressed and sintered glass developed by Corning Glass Works can be sealed directly to stainless steel. Multiform glasses (code No. 9019) are made from minute glass particles pressed to shape and then fired at high temperature. The particles are consolidated by fusion into a nonporous vacuum-tight structure. The process permits intricate shapes, holes and small radii to be formed economically in glass. Multiform glass can be fused to 430 Ti and 446 stainless steel in a low-compression type seal.

It has an expansion of 98.5 x 10^{-7} per deg C. Working point is in the 850 to 1,000 C range. Softening point is 683 C; annealing point 488 C; strain point 455 C. Density is 2.59 grams/cc. Log volume is 9.1 ohm-cm at 250 C, and 7.2 ohm-cm at 350 C.

Erie Resistor of Canada, Toronto.

Two new relays 139

A new miniature telephone-type relay, designated MH, is used in airborne computers, measuring devices, communication systems, etc., requiring switching elements controlled by a small signal voltage (approximately 1.6 watts at nominal voltage). The MH can switch up to 5 ampere, 115 v, 60 cps, resistive loads. It can be furnished to operate on ac or dc voltage or dc current, although ac operated models are limited to two poles and cannot be furnished enclosed.

An alternate pulse relay (originally designated PC) has been modified for easy installation on long production runs. A one piece frame permits mounting the new PA relay with a single bolt in a tapped #8-32 core. The relay transfers contacts when pulsed for approximately 30 milliseconds; the contacts are returned by the next pulse. No power is required once the contacts transfer. Contacts are rated at 7.5 amperes, 115 v, 60 cps for resistive loads. It can be furnished to operate on up to 230 vac; or up to 110 vdc. Switching arrangements up to 3 pdt are available on ac models, 4 pdt on dc models.

Potter & Brumfield Canada Ltd., Guelph, Ont.

Stroboscope measures tape speed 140

The Irish Stroboscope, designed to measure tape recorder speeds, consists of a Stroboscope disc mounted on a handle by means of low friction bearings. In operation it is held in lightly but firmly against the surface of the moving tape, preferably at the supply reel, while the recorder is operating. The disc will revolve and when viewed under a 60 cps incandescent light, will indicate the tape speed. Three speed rings are printed on the disc representing 3¾, 7½ and 15 ips.

Atlas Radio Corp. Ltd., Toronto.

Surface coating 141

Emerson & Cuming, Inc., Eccocoat C 26 is a clear epoxide surface coating for printed circuit boards, electronic circuits and components, metals and ceramics. It can be used continuously at 500 F and for short periods up to 600 F. Surface resistivity is above 10^{18} ohms at room temperature and remains about 10^{14} even at 500 F. Moisture and chemical resistance is good. The Eccocoat C 26 is applied by dip, brush or spray.

M. J. Howard & Co., Ottawa.

(Continued on page 50)

ONLY RAYTHEON® OFFERS BOTH SILICON TRANSISTORS

PNP·NPN

for COMPLEMENTARY CIRCUITS

because characteristics are so similar as to permit full and confident use

Specify RAYTHEON and get these significant advantages:

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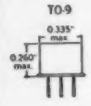
Made by the Raytheon reliable fusion alloy process which assures more constant characteristics over the entire temperature range

FOR LARGE SIGNAL APPLICATIONS

Temperature Range —65°C to +160°C

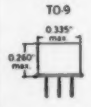


	Type	I_{EO} or I_{CO} at V_{CB} = 20 Vdc μA	V_{CE} max. volts	h_{fe}* avg.	h_{ie}* max. ohms	h_{oe}* max. μmhos	Noise* Figure db	C_{ob} f = 100Kc avg. μμf	f_{ab} avg. Kc
P	2N1034	0.005	−40	15	3000	70	30	65	200
N	2N1035	0.005	−35	30	3000	85	30	65	300
P	2N1036	0.005	−30	60	3000	100	30	65	400
N	2N1037	0.005	−35	30	3000	85	15	65	250
N	2N1074	0.005	50	15	3500	70	30	35	200
P	2N1075	0.005	40	30	3500	85	30	35	350
N	2N1076	0.005	30	60	3500	100	30	35	500
P	2N1077	0.005	30	25	3500	85	15	35	300

*V_C = 5V; I_E = 3mA

FOR SMALL SIGNAL APPLICATIONS

Temperature Range —65°C to +160°C



	Type	I_{EO} or I_{CO} at V_{CB} = 20 Vdc μA	V_{CE} max. volts	h_{fe}* avg.	r_b' f = 1Mc ohms	r_c kilohms	Noise Figure db (max.)	C_{ob} f = 100Kc avg. μμf	f_{ab} avg. Kc
P	2N327A	0.005	−40	15	1200	500	30	65	200
N	2N328A	0.005	−35	30	1400	500	30	65	300
P	2N329A	0.005	−30	60	1500	500	30	65	400
N	2N330A	0.005	−30	25	1300	500	15	65	250
N	2N619	0.005	50	15	2000	500	30	35	200
P	2N620	0.005	40	30	2500	500	30	35	350
N	2N621	0.005	30	60	2700	500	30	35	500
P	2N622	0.005	30	25	2400	500	15	35	300

*for PNP, I_B = −0.1mA; V_{CE} = −0.5V; for NPN, I_B = 0.5mA; V_{CE} = 1.5V

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Defense contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defense Production. A figure in parenthesis indicates the number of contracts, the amount being the total value.

January 16-31, 1959

Bayly Engineering Ltd., Ottawa, equipment, $19,255.

Computing Devices of Canada Ltd., Ottawa, radiacmeters, $378,544 (3).

Electronic Materials International Ltd., Ottawa, equipment, $23,409.

General Precision Industries Ltd., Montreal, equipment, $508,907.

G. M. Gest, Ltd., Montreal, replacement and extension of telecommunication cable, $24,740.

Lenkurt Electric Co. of Canada Ltd., Ottawa, equipment, $13,603.

TMC (Canada) Ltd., Ottawa, teletype equipment, $16,238.

EP Electric Products Co. Ltd., Montreal, ground antenna array — Cloverdale, N.B., $23,884 (contract awarded by Defence Construction [1951] Ltd.).

P. W. Graham & Sons Ltd., Moose Jaw, Sask., standard combined receiver-transmitter control tower building and outside services — Moose Jaw, Sask., $70,451 (contract awarded by Defence Construction [1951] Ltd.).

February 1-15, 1959

Addison Industries Ltd., Toronto, spares for radio equipment, $279,288 (2); radio equipment, $25,637.

Ahearn & Soper Co. Ltd., Ottawa, signal generators, $36,774.

Ampex American Corporation, Ottawa, tape recording system, $13,530.

Canadian Aviation Electronics Ltd., Montreal, spares for flight simulators, $36,161.

Canadian Motorola Electronics Ltd., Toronto, equipment, $12,877.

Canadian Westinghouse Co. Ltd., Ottawa, repair and overhaul of equipment, $10,000.

Computing Devices of Canada Ltd., Ottawa, equipment, $674,169.

Garrett Manufacturing Corp. of Canada Ltd., Rexdale, Ont., components, $11,282.

Instronics Ltd., Stittsville, Ont., equipment, $49,383 (2).

Measurement Engineering Ltd., Arnprior, Ont., signal generators, $19,240, equipment, $235,326.

R. H. Nichols Ltd., Downsview, Ont., cable assemblies, $14,765.

Northern Electric Co. Ltd., Ottawa, spares for radar equipment, $72,635.

Servomechanisms (Canada) Ltd., Toronto, modification of fire control equipment, $35,175.

Library — continued

Polyethylene Insulated Telephone Cable. Newsletter No. 39 describes PIC cables and improvements made since 1953. Northern Electric Co. Ltd., Lachine, Que. (114)

Chart with technical information and conversion data for Conrad environmental test laboratories and engineering departments. Beechey Enterprises, Toronto. (115)

Plastics for electronics. This 20-page brochure, Eccofoam, contains information on plastic and ceramic foams in electrical and electronic applications; published by Emerson & Cuming Inc., Canton, Mass. M. J. Howard & Co., Ottawa. (116)

Oscillographic recorder. Brochure discusses Model 670 X-Y Recorder; includes sections on power amplifier systems and application of Sanborn "150"; published by Sanborn Co., Waltham, Mass. Arva, Vancouver; R-O-R Associates Ltd., Don Mills, Ont. (117)

Treatise discusses fundamentals and applications of magnetic instrumentation recording; 74 pages. Ampex American Corp., Ottawa. (118)

Magnetic amplifiers. Bulletin No. 403-A is design manual with 45 diagrams and charts on amplifier design and application techniques. Acromag Inc., Detroit, Mich. (119)

Pulse transformers. A 24-page catalogue with history, charts and engineering data. PCA Electronics Inc., Sepulveda, Calif. (120)

System diagram. Brochure outlines features of Automatic Telephone & Electric Co. Mosaic Diagram with remote control and indication facilities. Automatic Electric Sales (Canada) Ltd., Toronto. (121)

Digital logic system. Twelve applications for Hoffman Magnalog logic modules are explained and illustrated in this 8-page brochure. Samuel C. Hooker (Canada) Ltd., Montreal. (122)

Chart of temperature-millivolt conversion tables for thermocouples. Thermo Electric (Canada) Ltd., Brampton, Ont. (123)

Price sheet and catalogue (T-258) on in-stock wire, cable and tubing. Birnbach Radio Co. Inc., New York. (124)

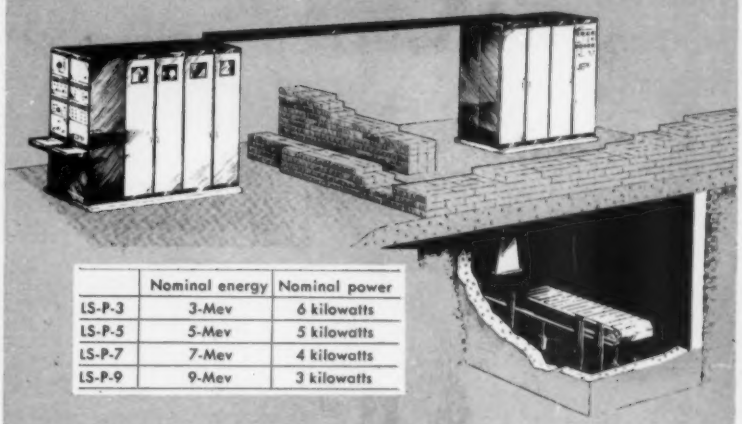
Selenium rectifiers. Illustrated 10-page catalogue of cell sizes, rectifier circuits and dc current ratings. Syntron (Canada) Ltd., Stoney Creek, Ontario. (125)

Measuring instruments. A 24-page catalogue on Rhode and Schwarz high-precision measuring instruments. The Ahearn and Soper Co. Ltd., Ottawa. (126)

Epoxy resin molds. Illustrated newsletter explains Cerro de Pasco slush casting process for encapsulating electronic components with epoxy resins. The Canada Metal Co. Ltd., Toronto. (127)

Microwave standards prospectus. A 36-page booklet describes latest techniques and instrumentation for making microwave standards measurements; published by Hewlett-Packard Co. Atlas Instrument Corp. Ltd., Toronto. (128)

LINEAR ELECTRON ACCELERATORS
designed and built by
HIGH VOLTAGE ENGINEERING
give
GUARANTEED PERFORMANCE
for Industry*



	Nominal energy	Nominal power
LS-P-3	3-Mev	6 kilowatts
LS-P-5	5-Mev	5 kilowatts
LS-P-7	7-Mev	4 kilowatts
LS-P-9	9-Mev	3 kilowatts

The new 118-series linac is a flexible, low-cost design — tailored to the needs of production electron-beam processing.

Guaranteed to meet or exceed specifications, these accelerators are conservatively rated for long industrial life.

The performance ratings of the linac models shown above are obtained from the same basic unit through the use of one of four interchangeable microwave acceleration tubes.

To meet power and penetration requirements of the future, the appropriate acceleration tube can be installed at nominal cost.

Installation time and cost are minimized in this design. Cost per kilowatt is the lowest in the microwave linear accelerator field.

Inquire about HIGH VOLTAGE linacs, now in use for production sterilization on a two-shift basis.

*Write our Technical Sales Department for further information on other accelerators for processing and research.

HIGH VOLTAGE ENGINEERING CORPORATION
BURLINGTON MASSACHUSETTS

For further information mark No. 26 on our Readers' Service Card

New products — continued

Heating generators 142

Type PH 1206, 6 kw high frequency dielectric heating generator has been designed for applications such as glue setting, drying and heating for nonconductive materials by means of high frequency. The generator is available with single and dual output.

Type PH 1004 (4 kw) and type PH 1006 (6 kw) high frequency induction heating generators each occupy a floor space of only 2 ft. square. They have been designed for hardening, brazing and soldering operations in small machine shops. Each generator comes complete with two sets of output terminals; one for use with multiturn and one for use with single-turn coils. A built-in variable hf output transformer is used to control the power into the workpiece and also permits almost complete freedom of coil design.

Philips Electronics Industries Ltd., Toronto.

Circular chart recorders 143

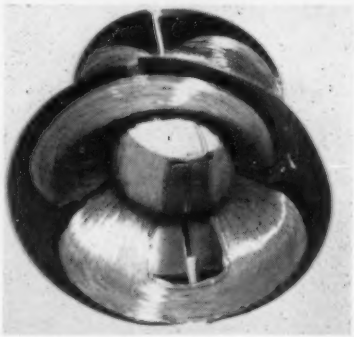
The Daystrom-Weston no-balancing, circular chart recorder-controllers, are designed for ac operation only; 115 v, 50 or 60 cps. Design features include 12" chart with full scale pen travel of 4⅝"; 33.86" long, 320 deg concentric scale; many standard calibration ranges for potentiometer or Wheatstone bridge; full-scale response time of 5, 10 and 20 seconds; standard chart speeds of 7 days, 48, 24, 12, 8, 4 or 1 hour per revolution.

The recorder is available with either electric or pneumatic controls. Pneumatic controls — in models 6836 (potentiometer) and 6856 (Wheatstone bridge) — are available as universal controller, proportional plus automatic reset, or proportional with automatic reset and derivative. Electric controls — in models 6833 (potentiometer) and 6853 (Wheatstone) — are available as contact type (two-position or three-position) and proportioning control with 5, 10 or 20% proportional band.

Daystrom, Ltd., Toronto.

Magnet wires 144

Two new magnet wires have been introduced. Isobond is a bondable film over polyurethane enamel. Its main features are its solderability at lower temperatures and a higher cut-through temperature than Bondel magnet wire. Principal use would be in the manufacture of form wound yoke coils.



Nythane magnet wire is a nylon coating over a polyurethane enamel. Its high solderability, abrasion resistance, chemical resistance and good windability makes it suitable for use in series armatures and fields, stators and other difficult winding operations. It is rated as a class A magnet wire and is available in natural or red colored finishes.

Both Isobond and Nythane magnet wires are available on spools, reels, or in pay-off-paks. Isobond is available in sizes 26 to 31 AWG. Nythane is available in sizes 13 to 31 AWG inclusive and in regular, single heavy, and triple enamel thickness.

Federal Wire & Cable Co. Ltd., Guelph, Ont.

Soldering iron 145

A new range of subminiature soldering irons manufactured by Oryx Electrical Laboratories Ltd., England, comes in a range of sizes from 1/16 in. diameter up to 3/16 in. and in a variety of shapes. They possess high heat efficiency with 6 watts producing 542 F in the smallest

See these
POLYPENCO® industrial plastics
at the
NATIONAL INDUSTRIAL PRODUCTION SHOW
Toronto—May 4-8

Highest quality and widest range of stock sizes available in:

... NYLON—rod, tubing, tubular bar, strip, plate, disc

... TEFLON*—rod, tubing, spaghetti tubing, tape, sheet, thin wall tubing

... NYLAFLOW® Flexible Nylon Pressure Tubing—up 2500 P.S.I., for pneumatic, gas and liquid lines

... Q-200.5 Cross-Linked Polystyrene—rod and plate

... K-51 Chlorinated Polyether—rod, tubular bar, strip

... NYLATRON® GS Nylon Molding Powders

... NYLASINT® Finely Divided Nylon Powders for cold pressing and sintering

... FLUOROSINT® TFE fluorocarbon resin parts

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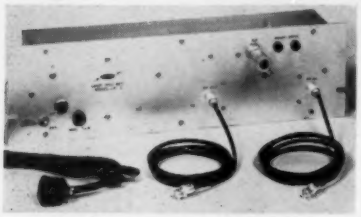
size and up to 932 F from 24 watts in the largest. A full range of interchangeable push-on tips in both solid nickel and nickel-plated copper alloy are available. The Oryx iron in the smaller sizes weighs less than ¼ oz and is only 6 in. long.

Len Finkler Co., Toronto.

Loop test set 146

By means of a control mechanism (either tone or dc) an operator at a terminal can carry out the following tests remotely on any duplex radio station equipped with the LP-2 loop test set; turn the remote station on; check that transmitter output and receiver sensitivity exceed present minimum standards; check transmission levels; check noise and interference; check station signaling facilities.



Transmitter frequency is 145-175 mc; transmitter-receiver frequency separation is 4-17 mc; over-all attenuation is 140-160 db (adjustable); power requirement is 115 vac, 10 watts.

Pylon Electronic Development Co. Ltd., Montreal.

Contour photocells 147

The International Rectifier Corp. contour photocells can be produced to any requirement (curved, cylindrical or other configuration) in three-dimensional shapes with as little as 1-in. radius of curvature.

Cell sizes range from a minimum of ¼ in. x ¼ in. to a maximum of 10 in. x 10 in. The cells consist of a metal base on which are deposited layers of selenium, cadmium and gold. The aggregate is treated in such a way as to be light sensitive.

Atlas Radio Corp. Ltd., Toronto.

Attenuator pad 148

Two versions of this 4 watt attenuator pad have been developed by Empire Devices Products Corp. for use in the frequency range of dc to 4,000 mc. One attenuator has six steps while the other one has 12 steps.

Instronics Ltd., Stittsville, Ontario.

(Continued on page 52)

CUT LAB EQUIPMENT COSTS IN HALF

HEATHKIT®

ELECTRONIC KITS

The Heathkit Model OP-1 Professional 5" DC Oscilloscope is an example of the top quality test instruments available from Heath at ½ the price you would expect to pay. This feature-packed kit sells complete for only $217.95.

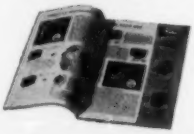
Heathkits give you twice as much equipment for every dollar invested.

The Heathkit Model V-7A is the world's largest selling VTVM. Precision 1% resistors are used in the voltage divider circuit for high accuracy and an etched circuit board simplifies assembly and cuts construction time in half. Price of this outstanding kit is only $35.95.

The Heathkit Model PS-4 Variable Voltage Regulated Power Supply Kit is another outstanding example of Heath Company engineering ingenuity. Truly professional in performance as well as appearance yet it costs only $74.95.

Stretch your test equipment budget by using HEATHKIT instruments in your laboratory or on your production line. Get high quality equipment without paying the usual premium price by letting engineers or technicians assemble Heathkits between rush periods. Comprehensive step-by-step instructions insure minimum construction time. You'll get more equipment for the same investment and be able to fill any requirement by choosing from more than 100 different electronic kits by Heath. These are the most popular "do-it-yourself" kits in the world, so why not investigate their possibilities in your business. Send today for the free Heathkit catalogue!

FREE CATALOGUE



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Compatible Automatic CENTRAL OFFICE TERMINAL EQUIPMENT for RADIO TELEPHONE SERVICE

NOW SECODE SIGNALING *"BRIDGES THE GAP"* BETWEEN WIRE AND WAVE

New Secode equipment solves the problem of extending subscriber service. By interconnecting radio and land line exchanges, complete telephone service is provided for mobile and remote rural users.

Central office terminals and associated equipment for interconnection between mobile radio circuits and either manual or automatic dial telephone exchanges are now in production. Secode equipment is fully compatible with Bell and Independent telephone practice. It is flexible, low cost, and simple to install.

Advantages of New Secode Dial Signaling Systems

Operates from standard telephone dial • Fully compatible with existing radio-telephone-standards • Telephone quality engineering for ultimate reliability • Individual mobile identification for automatic ticketing • Unlimited number of mobiles per radio channel • Ample call code capacity for nationwide numbering and roving service • No special instruction needed, mobile telephone operation simulates standard land line practice • Only the called mobile can answer a call • Only the calling mobile can seize and release a line • Full channel access for emergency communication • Conelrad control available • Repetitive ringing at the mobile • Superior fringe area operation • No FCC waivers required.

SEND FOR FREE BOOKLET An informative eight-page booklet titled, "Selective Signaling Equipment for Mobile Radio Systems" is yours for the asking. For your free copy along with the name of your nearest Secode engineering representative who will be happy to answer your questions, please address Dept. 774.

SECODE CORPORATION
SELECTIVE CONTROL DEVICES
The new name of ELECTRICAL COMMUNICATIONS, INC.
555 MINNESOTA STREET, SAN FRANCISCO, CALIFORNIA • MARKET 1-2643
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New products—cont.

Electronic circuit panel 149

The Siemens electronic circuit panel GS-DMZ consists of the following components mounted in a rack. The dc power supply provides voltages between 300 and 3,000 with an accuracy of 0.02%. The amplifier is linear and nonblocking. Its threshold sensitivity is near 0.5 mv and its amplification is variable in steps between the factors 2.5 and 10,000.

The ratemeter is able to measure

counting rates between 1 x 10^2 and 4 x 10^5 cpm in 9 measuring ranges with a precision better than ±2%. Counter and timer are of similar design, each comprising 6 electronic decade counting tubes and two binaries. They will operate over 15 various counts in the interval of 1 x 10^2 to 4 x 10^6 with 13 times values in the interval 0.1 to 400 min. The recorder is a high performance, electronically balanced strip chart instrument, with chart speeds of 120/300/-600/1200 mm per hr.

Viditon Corporation Ltd., Ottawa.

Reusable shipping containers 150

Kennett reusable shipping containers are available in three basic constructions — standard padded, dunnage board and shock cradle.

With standard padded reusable shipping containers, equipment is protected by a surrounding layer of shock-insulating padding covered with 9.5 oz. canvas. Padding is mounted on ⅛" Philippine mahogany plywood, giving additional strength to the container. Three different types of padding are available — rubberized hair, polyurethane or bonded

shredded foam rubber.

With dunnage board type containers, the equipment is protected from damage by being strapped or otherwise fixed securely to the board. These containers offer maximum versatility because of the wide diversity of equipment that can be enclosed within a single container.

With shock cradle types, the equipment is mounted in a lightweight cradle suspended by specially designed shock mounts. This method of mounting assures complete shock protection for delicate items, and allows for predetermined G loads to be built into the containers.

National Fibre Co. of Canada, Ltd., Toronto.

Silicon power rectifiers 151

Silicon rectifiers type 329 and 339 can provide average forward currents up to 160 and 240 amperes half wave maximum per cell respectively, with maximum peak inverse voltage rating up to 500 volts. Features of these new power rectifiers include: high ambient temperature operation — up to 190 C junction temperature; long life; high efficiency; low regulation; rugged construction and small size. The hermetically sealed cell is nickel plated and the rectifier case is the cathode terminal.

These cells are available in all types of rectifier bridge assemblies designed for either forced air or natural convection cooling.

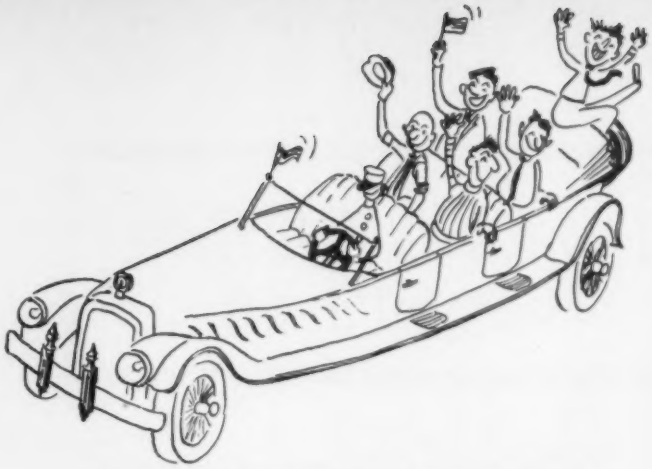
Canadian Westinghouse Co. Ltd., Hamilton.

High vacuum evaporator 152

Model VE-400 high vacuum evaporator is one of a series of modular 4 in. systems developed by Veeco. These systems permit the purchase of a high vacuum system, or evaporator, suited to a customer's present needs and permit additional equipment to be incorporated as it is required.

Radionics, Ltd., Montreal.

(Continued on page 54)



UNSUNG HEROES

We wish we could afford a newer automobile with an emblazoned banner for *each* of these gentlemen*, to tell the whole relay-using world of their accomplishments. For these are the souls who design that seldom-heralded product—the plebeian Sigma relay. Unlike more renowned Sigma engineers, they can never go home at night and say "Today I built a relay that will make history"; instead, their efforts will only keep someone's juke box, remote-controlled toy, electric blanket or burglar alarm working.

Here are five of their achievements that are about as experienced as relays can be; the "4", "5" and "41" have proved themselves since early WW II days, the others almost as long. Being old standbys also means they're for sale and deliverable in quantity.

* Perhaps you recognize the man on the spare tire as Mackinaw L. Mundane of April 1958 fame.

AC

DC

Series 4

Rugged, lightweight general-purpose SPDT design with adjustable pull-on and drop-out. Standard sensitivity 20 or 50 mw., rated 2 amperes resistive for 100,000 operations.

Built-in rectifiers. Operation comparable to DC performance, except for coil overload capacity and speed.

Series 5

Dual coils, SPDT, sensitivities from 1 mw. to 2 watts. High stability and shock resistance. Available adjustments include precision DC, close differential, meter protection, break-delay, etc.

Shaded pole version, for 60 cycle positive ON-OFF operation only. Standard sensitivity 0.3 volt-ampere. Type 11F — 1⅝" x 1⅝" x 1" high, wt. 1 oz. max.

Series 11

Small, low cost ($1.50-2.45) SPDT relay. Ideal for remote control units for toys and TV sets, door openers, etc. Mechanical life 100,000,000 operations. Four mtg. styles, unenclosed only.

Shaded pole SPDT design. Sensitivity 0.06 to 0.40 volt-ampere, 60 cps (specials for 16-400 cps.) Long life; quiet, inexpensive. Ratings up to 5 amperes resistive.

Series 41

DC sensitivities 40 to 200 mw. Fast, bounce-free switching; useful for keying; speeds to 100 pps. Shock and constant acceleration up to 100 g will not cause damage.

DPDT version of Series 41, but with 0.30 and 0.50 volt-ampere standard sensitivities. Standard frequency 60 cps, specials 16-400 cps. Contacts rated 2 or 5 amperes. Economical of power.

Series 42

DPDT version of Series 41, but with 100 and 200 mw. standard sensitivities. Can serve as output relay of many electronic controls; often used where UL approval is required. Contacts rated 2 or 5 amperes.

Bulletins on any of these Series on request.

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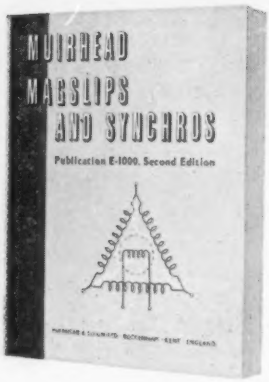
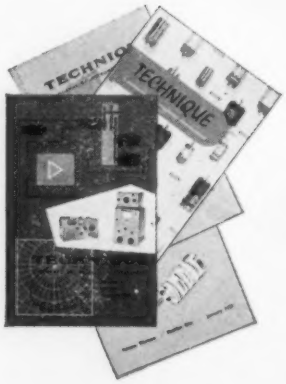
Publication E.1000
Second Edition

Free on request



A new edition of Publication E.1000 having four additional chapters on synchros has been prepared and will be distributed to all recipients of the first edition and any other synchro or magslip user on request.

TECHNIQUE



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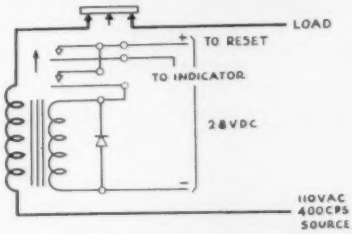
New products—cont.

400 cps overload relay 153

This Stegg PAS 201-1 400 cps relay has been designed for use with aircraft wing de-icing equipment.

Modern de-icing equipment provides several separate heating circuits which are extended along the leading edge of the wings. These are given short duration high currents on a rotation basis. The overload device must be instantaneously restorable and be provided with a lock-up to prevent current from flowing during the interval of the overload condition, then be restored when the load is cycled to the next heating element.

These conditions are met by the PAS 201-1 relay. It is designed as a dc type as shown in the illustration. One winding of the armature is connected in series with the 400 cps heater current. This is wound over a 28 v dc secondary coil. A silicon diode rectifier is connected in parallel with the secondary winding.



The heater current passing through the primary winding induces a voltage in the secondary in such a way that when the load current rises above the specified limit it provides the initial travel of the relay armature. This closes a "make" contact which applies the 28 v dc (from the aircraft power system) to the secondary to complete the armature travel and open the main contacts. Maximum deviation between the normal and overload current required to operate the relay is 1.5 amps.

Lake Engineering Co. Ltd., Scarborough, Ont.

Airborne transistor inverter 154

Designed as a direct replacement for mechanical inverters, this lightweight transistor inverter power supply is rated at 300 va, three phase, 400 cps, 115 v.

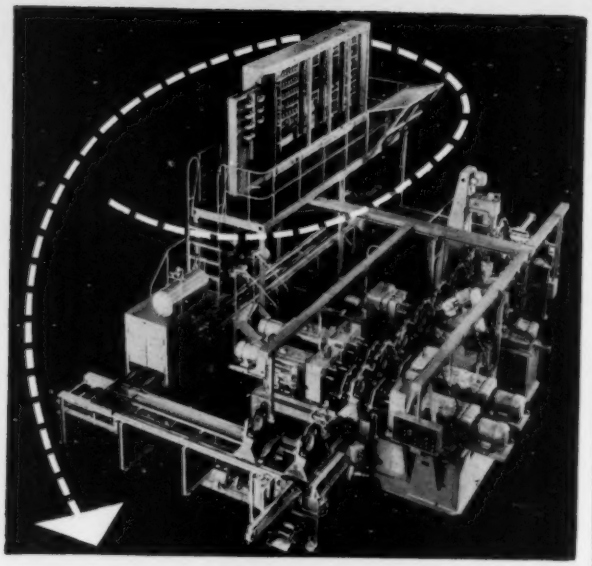
Canadian Westinghouse Co. Ltd., Hamilton.

(Continued on page 56)

SALES ENGINEER

WITH COMMUNICATIONS experience for component and apparatus sales to Electronic and Electro-Mechanical accounts in Ontario and Quebec. Applicants to be between 25 and 35 years of age with good electronics engineering experience and liking for sales work. Bilingual, asset but not essential. Position is salaried with prospects for advancement. Application should be made in writing to the Sales Manager giving full details of age, qualifications, experience and salary bracket to: Box 30, Canadian Electronics Engineering, 481 University Ave., Toronto 2, Ont.

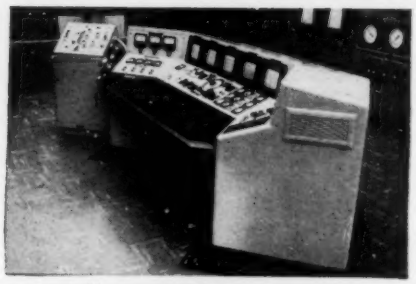
All applications held in strict confidence.



This complex Automation Equipment, engineered and built by Standard-Modern Tools Ltd., utilizes a Hammond fabricated Control Cabinet.

Consult HAMMOND

. . . at the design stage on ELECTRONIC-ELECTRICAL CABINETRY and METAL WORK



A Hammond built control console in use at Atomic Energy of Canada, Chalk River.

Hammond is equipped to produce intricate cabinetry and metal work related to the nucleonic, electronic and electrical industry.

The factory will be pleased to discuss *your* requirements on production runs, production prototypes or single units, and suggests that enquiries should originate at design level wherever possible.

A WIDE RANGE OF STANDARD CABINETS, PANELS AND CHASSIS STOCKED BY JOBBERS COAST TO COAST

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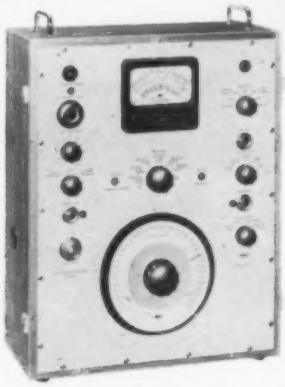
NEW AUDIO SPECTRUM ANALYZER

The Audio Frequency Spectrometer Model 2110 is designed for electrical, electro-acoustical, and vibration measurements and analyses in the frequency range 2 c/s to 35000 c/s.

A unique feature is an internal arrangement to facilitate direct connection to the chart motor of the level recorder Model 2304. This connection provides continuous scanning of the filters and enables a complete frequency-amplitude analysis of complex signals to be recorded automatically on preprinted, frequency calibrated recording paper.



The rectifier and meter circuit of the spectrometer can be switched to measure either the peak, the arithmetic average or the true R.M.S. value of the input signal.

OTHER OUTSTANDING CHARACTERISTICS INCLUDE:

Frequency Range:
"Linear": 2 c/s to 35000 c/s within ±0.5 DB (±0.3 DB in the range 5 c/s to 20,000 c/s).

Sensitivity:
Max. 100 uV full scale deflection. Min. 1000 volts. Variable in steps of 10 DB.

Amplification:
Max. 100 DB. Amplifier noise referred to input and max. gain: Approx. 15 uV with open input and approx. 5 uV with short-circuited input.

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BRUEL & KJAER

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Standard Signal Generator...

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for mobile communications . . .

- Frequency ranges 25-54, 140-175, 400-470, 890-960 Mc.
- Fine tuning control shifts carrier ±8 Kc.
- Peak deviation to ±16 Kc. read directly on meter.
- Residual FM less than 100 cycles at 460 Mc.
- Output 0.1 to 100,000 microvolts accurate ±10% across 50 ohm termination.
- Excellent stability.
- Modulation by 1000 cycle internal or by external source.

Laboratory Standards — WRITE FOR BULLETIN

MEASUREMENTS
A McGraw-Edison Division
BOONTON, NEW JERSEY

For further information mark No. 28

New products—cont.

Parametric rf preamplifier 155

Microwave Associates, Inc., have introduced a low noise parametric rf preamplifier designated MA-1C. This Harris type preamplifier, when coupled to conventional uhf receivers operating in the 350-500 mc band, achieves improved low noise receiver performance. Over-all receiver noise figures below 1.0 db (approximately 80 deg Kelvin) are achieved with band widths of approximately 1% throughout the specified tuning range.

The preamplifier performs as a straight-through parametric low noise amplifier with rf output obtained at the signal frequency. The Varactor which is used as the working element is relatively insensitive to rf burnout and cross modulation effects.

E. G. Lomas, Ottawa.

Instrument dust cover 156

PIC Design Corp. is offering a series of plastic breadboard and instrument dust covers. These flexible plastic covers, designed to prevent dust, dirt and grit from entering precise gear meshes and ball bearings, are available in a wide variety of sizes.

TecNeek Associates, Montreal.

Soldering is EASIER FASTER BETTER with American Beauty Soldering Tools

American Beauty electric soldering irons are the highest quality made. The finest engineering, best materials and on-the-job experience since 1894 is yours with every American Beauty. There is a right model, correct tip size and proper watt input to do any soldering job easier, faster and better.

TEMPERATURE REGULATING STANDS
Automatic devices for controlling tip temperatures while iron is at rest—prevents overheating of iron, eliminates frequent retinning of tip, while maintaining any desired temperature. Available with perforated steel guard to protect user's hand.

201-B

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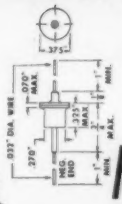
Tarzian F SERIES SILICON RECTIFIERS

- Positive Environmental Seal
- Extra Heavy Duty Junction
- Low Cost
- Axial Leads (No Heat Sink)
- Low Forward Drop
- Low Reverse Current

AMPERES D.C. (100°C)	PEAK INVERSE VOLTAGE	TARZIAN TYPE	MAX. RMS VOLTS	MAX. RECURRENT PEAK AMPERES (100°C)	MAX. SURGE AMPERES 4MS
0.75*	200	F-2	140	7.5	75
	400	F-4	280	7.5	75
	600	F-6	420	7.5	75

*.75A to 55°C, .5A @ 100°C.

Tarzian H SERIES SILICON RECTIFIERS



- Hermetically Sealed (Double Seal)
- Heavy Duty Junction
- Low Cost
- High Efficiency
- Axial Leads
- Low Forward Drop
- Low Reverse Current

AMPERES D.C. (100°C)	PEAK INVERSE VOLTAGE	TARZIAN TYPE	MAX. RMS VOLTS	MAX. RECURRENT PEAK AMPERES (100°C)	MAX. SURGE AMPERES 4MS
0.75*	100	10H	70	7.5	75
	200	20H	140	7.5	75
	300	30H	210	7.5	75
	400	40H	280	7.5	75
	500	50H	350	7.5	75
	600	60H	420	7.5	75

*.75A to 55°C, .5A @ 100°C.

Write for design notes No. 30 and 31

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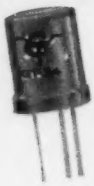
GENERAL TRANSISTOR



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FOR TODAY'S ELECTRONICS

The transistor has in a few years become an important part of today's Electronics Industry. There are countless applications for transistors in a vast range of products.

GENERAL TRANSISTOR make a complete range of transistors to suit all purposes and to meet the exacting requirements of industrial and experimental work as well as replacement transistors for commercial applications. GENERAL TRANSISTOR types are available from our stock for immediate delivery. There are equivalent models in this line to match the specifications of almost all types.

FREE! Complete GENERAL TRANSISTOR cross-reference guide showing the GT equivalents for all other makes — FREE on request!

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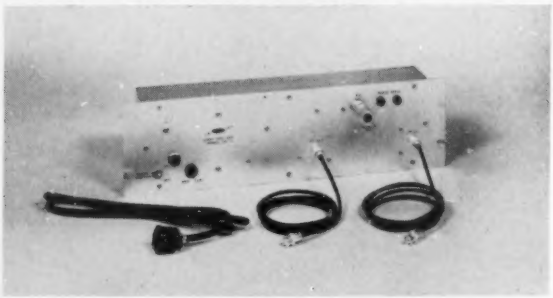

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FOR DUPLEX RADIO SYSTEMS

In most situations the LP-2 will pay for itself in direct savings in the first year of service.

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STOPPED *making our own etchant and* STARTED *using* HUNT S.C.E.

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1. Etches rapidly at room temperature.
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6. Is a prepared solution with guaranteed uniformity and rigid laboratory control.

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For detailed information about HUNT S.C.E. and valuable production handling information, write for Technical Bulletin No. 3 — "The Etching of Solder Plated Circuit Boards by Hunt S.C.E. Solution."

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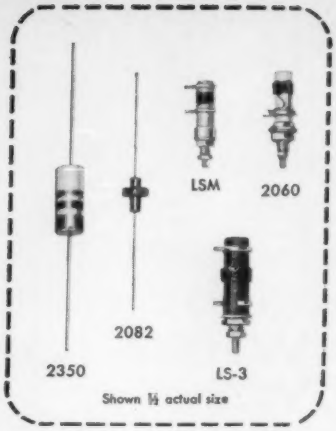
Wound to Meet Your Prototype and Production Needs



CAMBION® standard wound coils are available in types and sizes covering requirements in the broadest range of frequencies. Wound on ceramic or phenolic forms — vertical for conventional circuits and vertical and horizontal for printed circuits — many feature the Perma-Torq® tensioning device, which allows locking of tuning cores while still tunable. Special windings on shielded forms available to meet your needs.

Most prototype specifications can be filled from the broad CAMBION coil line. Unusual requirements can be handled by the widely-known CAMBION 0-8 Laboratory Coil-Development Department. And for your regular production, count on the same quality in any quantity. Another excellent aid for prototypes or lab experimenting is the CAMBION Coil Kit, containing 10 coil forms wound in overlapping inductance ranges from 2 μh to 80 μh. For complete details, write to Cambridge Thermionic of Canada, Ltd., 2425 Grand Boulevard, Montreal 28, P. Q.

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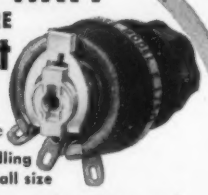
OHMITE®

THE QUALITY LINE OF INDUSTRY-PREFERRED COMPONENTS

12½-WATT MINIATURE Rheostat



ACTUAL SIZE
Model "E"
Only ⅞" Diameter
Weight: 0.52 Ounce

High power handling capability for small size

Model "E" has a ceramic base and ring-shaped ceramic core. The entire assembly is a miniaturized version of time-proven Ohmite power rheostat design. Resistance range: up to 5,000 ohms with 23 stock values; higher values available with OHMICONE inorganic coating. Resistance tolerance: ±10%. Ten other sizes available from 25 to 1,000 watts. BULLETIN 157.

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RESISTORS RELAYS TAP SWITCHES
RHEOSTATS TANTALUM CAPACITORS
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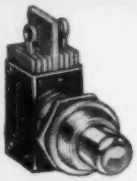
SMALLER - LIGHTER - STRONGER ARROW-HART Appliance Switches



A COMPLETE RANGE

For vacuum sweepers, fans, power tools, etc., and radio and electronic equipment.

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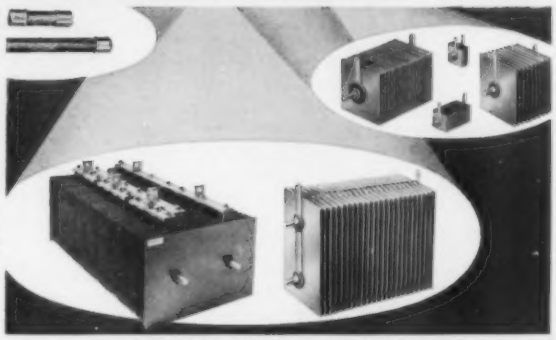

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Canadian instrument specialists discuss technical advances

We can sell em a spot of germanium,
We can sell em a lot of uranium,
But let us warn Dief
That he is buying us grief
When he exports grey stuff in its cranium.

—Sir Robert Watson-Watt

When Sir Robert quoted this poem at the opening luncheon of the Canadian Aircraft Industry Instrumentation Symposium, it drew a great round of applause. All of the members present had been affected in some way by the recent cancellation of the CF-105 contract, and some of the prospective delegates had already been "exported."

Despite the rather discouraging circumstances, the symposium met with good success. About 150 delegates registered in for the two-day session.

All technical papers were printed in time to be given out to delegates as they registered. The sessions, then were devoted to discussion of points of interest.

Another good feature was a series of private conferences. Delegates listed their field of specialization so that others could confer with them on an individual basis.

The symposium was sponsored by the Toronto section of the Instrument Society of America.

Call for technical papers

The technical program committee is asking for papers to be submitted for the IRE Canadian Convention to be held in Toronto, October 7-9. Authors should submit a 500-word summary, from which the committee can judge the suitability of the paper, and a 100-word abstract for insertion in the technical program. Send these to Mr. D. K. Ritchie, IRE Canadian Convention, 1819 Yonge St., Toronto 7, Ont. Deadline is May 31.

Authors wishing to present papers at the Fifteenth Annual National Electronics Conference, Chicago, Oct. 12-14, should submit abstracts of 200 words or less to M. E. Van Valkenburg, Electrical Engineering Dept., University of Illinois, Urbana, Illinois. Ten copies of the abstract are required and the deadline is May 1.

Hi-fi theories challenged

Recent studies indicate that some present audio engineering theories are obsolete, claims John G. McKnight, Ampex Corp. It has been generally accepted by engineers that most of the power in musical sound is concentrated within only a few octaves in the middle register. But according to Mr. McKnight, the peak energies at the upper and lower extremes of the audible range are substantially as great as those in the mid-range.

Future equipment must have not only a flat frequency response, but also a power range which is essentially linear throughout the audible spectrum.

Wholesalers' convention

The fourth annual national meeting and convention of the Canadian Electronic Wholesalers' Association will be held at the Fort Garry Hotel, Winnipeg, April 13-15. Attendance of members from across Canada is expected to exceed any previous national CEWA convention.

Opportunity will be provided for suppliers to meet the wholesalers attending the meeting, and it is planned to invite all segments of the electronics industry to attend the convention dinner on April 14.

Electronic parts distributors show

Canadian interest at the Electronic Parts Distributors Show will centre around the Canadian Headquarters in room 419 of the Conrad-Hilton hotel, Chicago. Charles W. Pointon, chairman of the Canadian Electronic Sales Representatives, will act as host at the headquarters during the show, May 18-20.

The 16th annual Canadian luncheon will be held May 19, commencing with a reception at 12 noon. On Wednesday morning at 8.30, the members of the CESR will hold their annual breakfast meeting.

COMING EVENTS

April

5-10 Fifth Nuclear Congress. Cleveland, Ohio.

6-9 British Radio and Electronic Component Show, Grosvenor House and Park Lane House, London, W.1.

16-18 Southwestern IRE Regional Conference & Electronics Show. Dallas, Tex.

16-30 Engineering, Marine, Welding & Nuclear Energy Exhibition, Olympia, London.

May

4-6 National Aeronautical and Navigational Electronics Conference. Dayton, Ohio.

4-8 National Industrial Production Show of Canada, Exhibition Park, Toronto.

6-8 1959 Electronic Components Conference. Philadelphia, Pa.

21-27 International Convention on Transistors. Savoy Place, London, W.C.2.

June

8-10 Canadian National Business Show, Exhibition Park, Toronto.

12-28 Electrama, general exhibition of the French Electrical Engineering Industries, including electronics. Paris.

13-22 International Conference on Information Processing. Palais d'Exhibition, Paris, France.

August

26-Sept. 5 26th National Radio and Television Exhibition, Earls Court, London.

October

7-9 IRE Canadian Convention, Exhibition Park, Toronto.

New equipment helps telephone companies

A major problem facing the communications system planner is that of achieving a satisfactory compromise between economic considerations and the grade of service desired. S.E.A. Pinnell will present some of the facts in the May issue of CEE, then go on to describe the role of compandors.

The transistor as a 4-terminal network, Part 2: Gain considerations concludes the work by M. A. Gullen.

The editors of CEE attended the IRE National Convention and will report on significant aspects in next month's issue.

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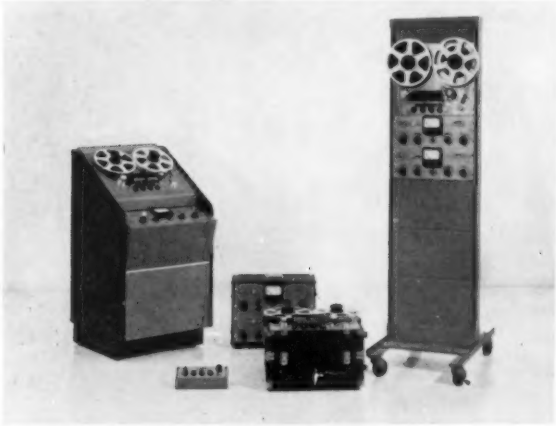
Standard of the professional recording industry, it consistently delivers the finest in audio reproduction. Available in as many as 8 channels, in console and rack mounting.



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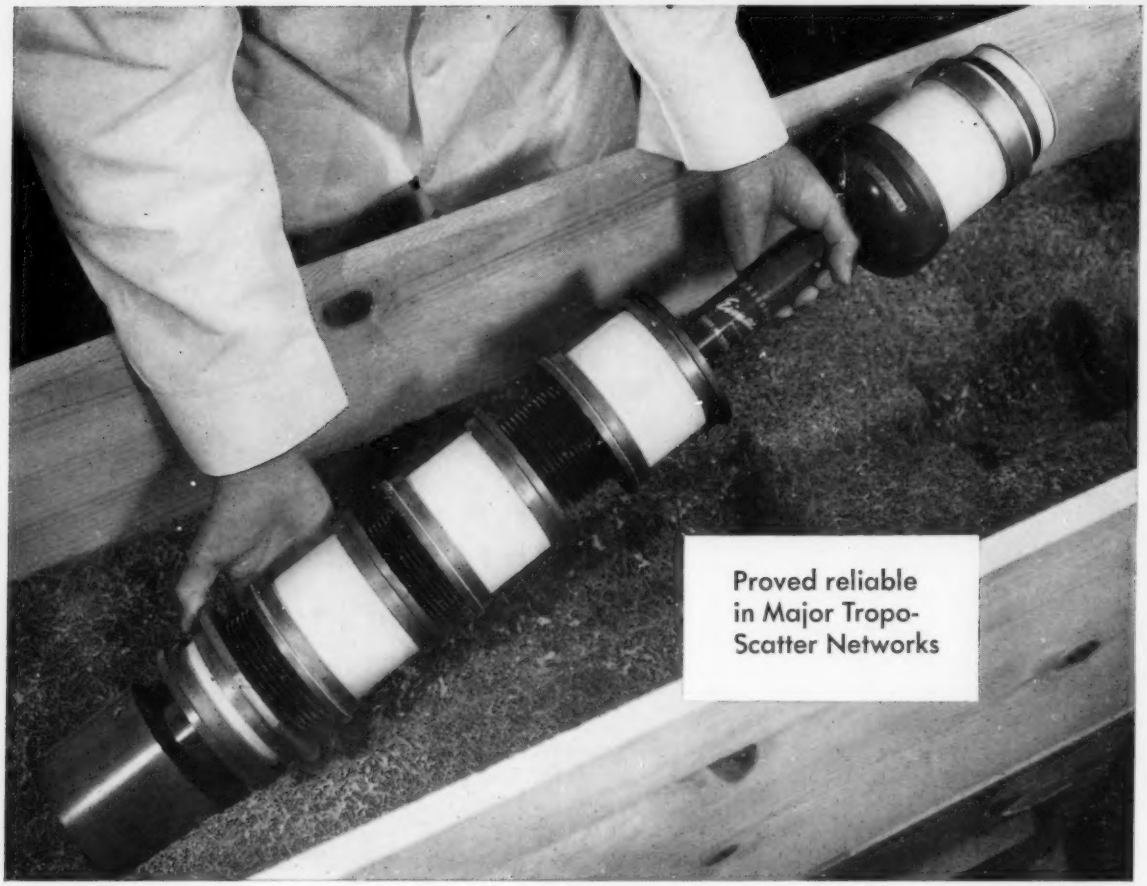

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